NOVEMBER

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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MARK F. FINLEY, D.D.S.
(1856-1932)

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Original Communications

PORCELAIN INLAYS*

By J. E. ARGUE, D.D.S., Seattle, Wash.

THE ability to master a refined technic in all branches of operative dentistry can be developed only by expenditure of effort and time.

The esthetic possibilities that porcelain presents no doubt represent the highest art in dentistry. The beautiful natural effect that may be reproduced in color, form and arrangement of the human teeth is a contribution to art which is much appreciated by people of discernment.

While the porcelain inlay has its place in saving the teeth, there have been too many cases in which the porcelain jacket crown has been placed where the natural beauty of the teeth could have been preserved for some time.

In certain selected surfaces of the anterior teeth, where there are cavities of initial decay, if the outline and the proper technical procedure are carefully carried out, porcelain inlays can be placed with a most artistic result.

*Read before the Pacific Coast Dental Conference, Seattle, Wash., July 6, 1932.

Porcelain is a friable material and the thin cavosurface angles should not be placed in direct occlusion in opposing teeth. Its use should be confined to the surfaces of the teeth that are most observed when the lips are drawn back in the usual smiling expression of the mouth.

CAVITY PREPARATION

In operative dentistry, there has been unnecessary cutting of the normal sound tooth in outlining cavities to give access in the placing of fillings or for other reasons. A number of our most eminent men in recent articles have called this fact to the attention of the profession, and the mistake has been partially corrected. The restriction of cavity outlines for all classes of fillings, in order to conserve tooth structure, assures a more stable and lasting inlay and adds to its esthetic value 100 per cent.

With porcelain, bulk must be added for strength. This rule has been handed down to us by men of wide experience in dealing with all classes of porcelain

operations. The wisdom of this principle cannot be questioned, and it should be applied especially in porcelain jacket crown operations, and also in making porcelain pontics, in fixed bridgework.

I have a suggestion to offer that we make it necessary to apply this in only a limited way in porcelain inlay operations, because the cavity outlines must be restricted to conserve normal tooth structure.

In reviewing the articles that have been written on porcelain inlays in the past years, I am impressed with the fact that some have given too much consideration to extending the outlines of the cavities in order that porcelain may be added for strength. (Figs. 1-3.)

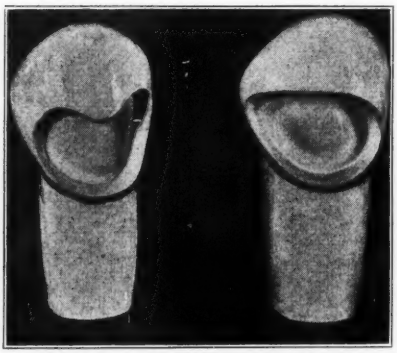

Fig. 1.—Cavity preparation; showing unnecessary cutting of normal tooth structure.

To comply with the modern methods of operative dentistry, we must give more thought and study to this problem. My suggestion is, in the first place, that porcelain be used only in the surfaces of the anterior teeth that are most observed; which fulfils the first requisite, the esthetic. This would include the classes of cavities (3, 4 and 5) shown in Figure 4.

In Class 3 cavities, in the proximal surfaces of the cuspids and incisors, the porcelain would not come under direct occlusal stress, and therefore no extensive outline is necessary for bulk, and access should be had by some method of separation of the teeth.

Class 5 cavities in the gingival third of the labial and buccal surfaces do not come in direct occlusion with the opposing teeth, and the access is easy. Therefore, in these two classes of cavities, the outline can be restricted, only a reasonable amount of bulk being allowed for strength, consideration then being given principally to outlining the cavities to assure immunity to decay.

In Class 4, in the proximal surfaces, including the incisal angles in the incisors and cuspids, to obviate bulk for strength, somewhat of a different method can be employed in the upper teeth by first restoring the labial surface with porcelain and reinforcing the porcelain to provide for incisal stress by placing a gold inlay and to restore the lingual and incisal surfaces. This is known as a combination porcelain and gold inlay. (Fig. 5.)

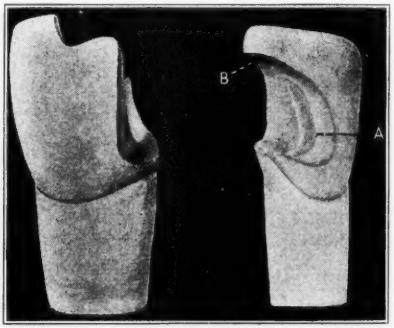

Fig. 2.—Cavity preparation; showing unnecessary cutting of normal tooth structure.

By this method, we can conserve tooth structure to a maximum degree.

In no case would use of a combination

porcelain and gold inlay in a Class 4 cavity of the lower incisor or cuspid teeth be recommended, for the reason that the outline for the gold part of the inlay would necessarily be carried to quite a degree over the labio-incisal surface, for strength to protect the porcelain from the occlusal stress of the upper teeth.

This display of gold would be very undesirable from an esthetic standpoint.

In forming cavities, the principles laid down by Drs. Black, Wedelstaedt and other authorities on operative dentistry should be followed closely. They are classified as follows: 1. Outline form. 2. Retentive form. 3. Resistance form. 4. Convenience form. 5. Marginal form.

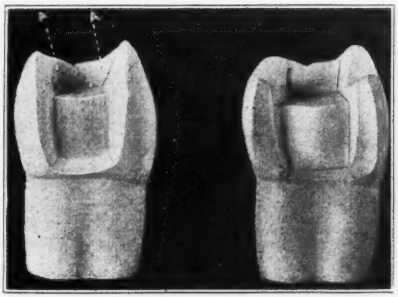

Fig. 3.—Impractical use of the porcelain inlay.

6. Removal of decay and toilet of the cavity.

The outline form is of particular importance in porcelain inlay operations in view of the fact that when it is carried out along the proper lines, the inlay is less perceptible to the eye, and therefore a more esthetic result is obtained. The outline, then, should be extended only to an immune area; which also conserves tooth substance as much as possible.

In Class 3 cavities, in the proximal surfaces of the upper and lower incisors and cuspids, guttapercha should be placed in the cavity for twenty-four hours to separate the teeth, or, under procain, separation can be made direct. Separation is necessary for access in preparing the cavity and making the impression. (Fig. 6.)

The gingival outline should extend just below the gingiva, thus following its curvature labiolingually; but if recession of the gingival tissue has taken place, in older patients, the margin is not carried under the gingiva.

The labial and lingual outline should be well beyond the contact point, depending entirely on the approach of the approximating surface. The outline is so extended that the inlay will be

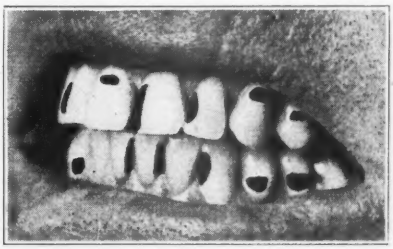

Fig. 4.—Classes of cavities in which porcelain inlay may be placed for esthetic value.

kept clean by the excursions of the food and the motion of tongue and lips. Running gingivo-incisally, on the labial and lingual surfaces in the general direction of the lobes of the teeth, it meets the gingival outline. This line of meeting must be rounded to give bulk of porcelain, as much edge strength as possible being added to the filling at that point.

The incisal outline should be nearly at right angles to the labial and lingual outlines and beyond the point of contact incisally, meeting the labial and lingual outline in a short curve.

In making this outline, the greatest

care should be taken not to weaken the incisal angle.

Class 4 cavity outlines, for cavities in the proximal surfaces of the incisors and cuspids, including the angle are shown in Figure 7. The gingival outline would be the same as in Class 3. The labial and lingual outline would differ in that they would extend on a straight line to the incisal outline, which should be made last.

In the upper teeth, a combination of porcelain and gold inlays should be placed. Hard gold is used, as thin as possible to be consistent with the strength necessary to protect the porcelain from the incisal stress of the lower teeth. (Fig. 8.)

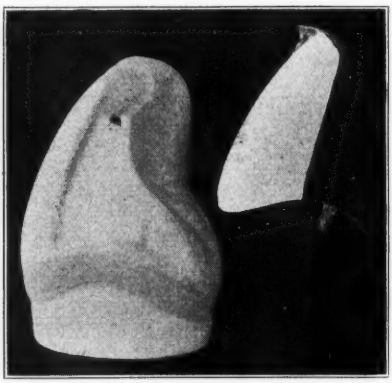

Fig. 5.—Combination porcelain and gold inlay to reinforce incisal angle of porcelain.

Gingivo-incisally, the labial outline should only be extended 0.5 mm., and the lingual, about 2 mm.; this then running mesially or distally, as the case may be, to a point just beyond the middle of the middle lobe of the tooth, extending then to the incisal surface at right angles, with the angles slightly rounded.

In this way, the display of metal is minimized at the labio-incisal aspect, strength being increased by the linguo-incisal extension, giving the best possible esthetic result and protecting the porcelain from the stress of the opposing teeth.

Class 5 cavities in the gingival third of the labial and buccal surfaces are shown in Figure 9. The outline for the gingival surfaces should extend just beneath the gingiva when the gingival tissue is normal; otherwise not.

Mesially and distally to a point just within the mesiolabial and distolabial angles, along straight lines, conforming to the general direction of the lobes gingivo-incisally, the incisal outline should vary according to the form of the labial or buccal surface, extending only to a point as far as caries has progressed incisally. These outlines should meet at slightly rounded angles to assure the greatest edge strength to the inlay at this point.

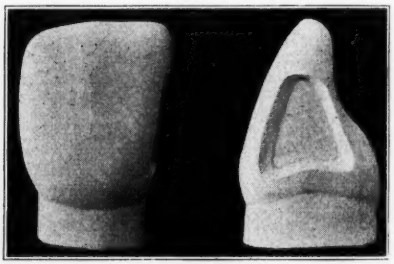

Fig. 6.—Outline of Class 3 cavity in central incisor.

The retentive form for a porcelain inlay is made by forming definite walls and angles.

In Class 4 cavities, a pit is sunk in the gingival wall lingually, and, in the pulpal wall, mesially or distally, as the case may be, with a 56 fissure bur, to a depth of one half the length of the leaves of the bur. (Fig. 10.)

This reproduces two spurs on the gold

portion of the inlay, thus giving additional anchorage to the inlay when the porcelain of the labial half of the inlay is cemented to place first.

Then, the gold, including the linguoincisal part of the inlay, is cemented to place, covering the porcelain incisally and thus giving it a retentive form on that surface.

Resistance form is assured by broad flat gingival and pulpal walls, these in all cases meeting the axial wall at acute right angles.

Convenience form is applied in cavities of initial decay in proximal surfaces, no more of the tooth being cut away than would be necessary to establish the outline in the immune area. Beveling the labial wall labially and proper separation make the cavity more accessible in taking the impression and in placing the completed inlay.

In case of extreme caries in Class 3 cavities (Fig. 11), the lingual wall is usually weakened greatly, and it can be cut away, this giving all the access necessary to place the inlay from the lingual surface.

Marginal form concerns the management of the enamel rods. A knowledge of the histologic structure of the enamel is necessary to determine the direction of these rods on the different surfaces of the teeth.

In porcelain inlays, the marginal form differs from that cut for gold in that it is not subjected to mallet force in the operation, and does not require beveling. Therefore, the enamel is trimmed on a line with the long axis of the rods; which gives porcelain an equal advantage in standing the stress.

In the combination porcelain and gold inlay, the enamel is given a bevel for the gold portion of the inlay.

Fig. 7.—Cavity preparation for combination porcelain and gold filling.

REMOVAL OF DECAY AND TOILET OF THE INLAY

Any slight decay and discoloration remaining in the interior of the cavity after the walls have been definitely formed may be left until the impression has been taken, in order to avoid undercuts. Then, with spoon excavators, the decay and stained dentin should be carefully and thoroughly removed, and if silicate cements are used to set the inlay, the walls should be very slightly undercut to give additional anchorage. The toilet of the cavity is

not made until the inlay is completed and ready to set.

ADAPTATION

Porcelain operations are somewhat like gold castings, in that they are to be fitted in the tooth cavity with a cement joint.

The gold can be fitted and sometimes burnished to make a closer fitting joint. It is very different with the porcelain inlay, which must be made to fit definitely at the cavosurface angles, because, owing to its physical properties, there is no way to change or improve the fit of the completed inlay. The only possible treatment is to polish it down to the tooth's surface, and this should be done only to a very limited degree. Therefore, a most exacting technic must be employed to make as close an adaptation as possible.

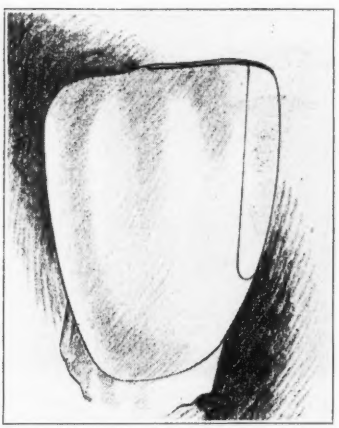

Fig. 8—Minimizing of gold at labial incisal aspect.

FORMATION OF THE PLATINUM MATRIX

There are two methods of forming the matrix for a porcelain inlay, the direct and the indirect. Advantages are claimed for both, and I would say that, when a careful technic is followed out, satisfactory results can be obtained with either. I am partial to the direct method for the following reason: I believe that a more accurate adaptation of the platinum matrix is possible when it is burnished at the cavosurface angles, directly in the cavity; which assures an inlay with less overhang and a closer fitted clean joint of porcelain at the cavosurface angles.

I shall here outline in detail a technic which with patience and care in the execution will, as I have found in my experience, assure results that repay the operator for the extra effort put forth.

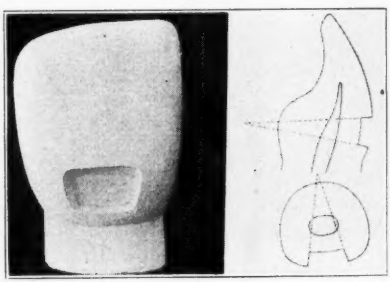

Fig. 9.—Outline of cavity in gingival third of labial surface of upper central incisor.

PROXIMAL SURFACES

In Class 3 cavities, separation is quite necessary for convenience in forming and removing the completed matrix. In Class 4, separation is not necessary. (Fig. 12.)

Platinum foil rolled to one thousandth inch thickness is used. The matrix is cut 1 mm. larger than the outline of the cavity, at all points. The piece of platinum is set to place with a pair of foil pliers, and a flat burnisher is first used to carry it over the cavosurface angles. (Fig. 13.)

Then, a piece of spunk that will fill the cavity is moistened, pressed against the platinum and forced into the cavity with an orangewood point.

With a flattened orangewood stick cut to a point, and with the aid of the mallet force, this spunk is wedged into the cavity, which carries the matrix against the walls and down partially into the angles. A No. 24 burnisher is used to outline the cavosurface angles somewhat and burnish the platinum down over the tooth surface. The spunk is removed and a strip of medium rubber

Fig. 10.—Bulk of hard gold on the lingual aspect for strength.

dam is passed around the tooth, over the platinum, where it is held tightly while the burnishing is done, first by a larger ball burnisher, then a smaller one, working well down into the cavity. With a No. 6 E burnisher the angles are reached; which gives a clean angular outline to the matrix, reproducing the gingivo-axial, linguo-axial, labio-axial and inciso-axial angles.

The matrix is then removed and trimmed, about 1 mm. overlap being left at all points except at the linguo-cavosurface angle. At that place, it should be trimmed so that it barely covers the angle. (Fig. 14.)

This enables the operator to remove the matrix from the labial surface with much greater ease. It is then replaced in the cavity, respunked with mallet force on an orangewood stick and the rubber dam strip passed around it and held firmly, while it is given a very careful reburnishing at all points.

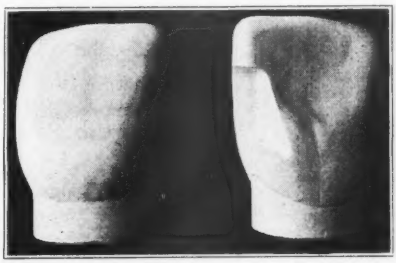

Fig. 11.—Class 3 cavity in mesial surface of upper central incisor showing lingual wall cut away.

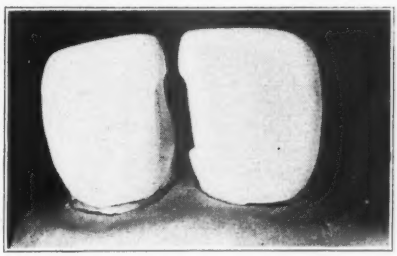

Fig. 12.—Upper incisors separated about as much as would be necessary.

Care should be taken in its removal from the cavity not to change its form in the least, and if the proper care is used in baking the porcelain, no change whatever will take place in the matrix.

In Class 5, or labial surface, cavities, a somewhat different system is employed, as here the placing of the matrix in the

cavity with walls more at right angles is difficult to accomplish without tearing the platinum, and I wish to present a simple technic which overcomes this difficulty.

An orangewood stick is shaped 0.25 mm. smaller than the cavity outline; which allows room for the matrix between the orangewood and the cavity wall when the matrix is carried to place.

A piece of platinum foil, cut about 2 mm. larger than the cavity outline, is folded over the end of the orangewood (Fig. 15), then introduced and, with mallet force, driven down the full depth of the cavity. The orangewood is held firmly with the left hand, while, with a No. 2 flat burnisher, the platinum that protudes is unfolded and burnished over the labial surface. (Fig. 16.)

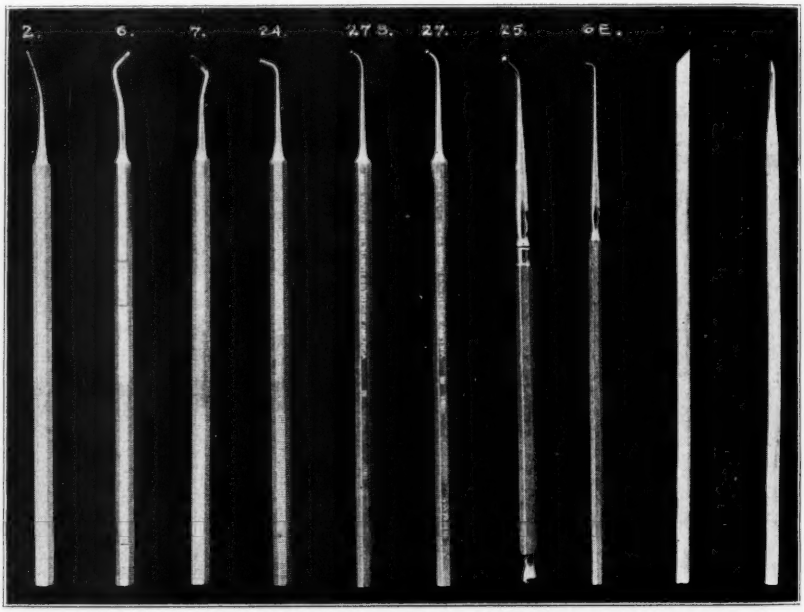

Fig. 13.—Comparatively few burnishing instruments necessary. *6E*, No. 6 explorer with point rounded off. The orangewood sticks are shaped flat and cut to a bevel point, for matrix swaging.

A medium sized orangewood stick is selected, the end of which is painted with hot modeling compound. This end is set in the moistened cavity, chilled and removed. This is done to aid in trimming the orangewood end to the form and size of the cavity, which is done with a sharp sealpel.

The orangewood is removed and wet spunk placed. Mallet force is then applied on the orangewood (which wedges the spunk, thus forcing the matrix against all walls of the cavity and outlining the cavosurface angles somewhat). The matrix is now burnished over the cavity margin on the tooth surface.

The matrix is removed and trimmed, from 0.5 to 1 mm. overhang being left. It is again replaced in the cavity and swaged to place with the spunk by means of the orangewood. The spunk is then removed and a very careful final burnishing given, with the No. 6 E explorer, burnishing into all the angles. At this point, gum camphor is placed in the matrix. Then by use of mallet force on an orangewood stick with a square end and larger than the cavity, the gum camphor is wedged into the cavity, and more added till it overflows the cavosurface angles. In this way, the final swage is given the matrix.

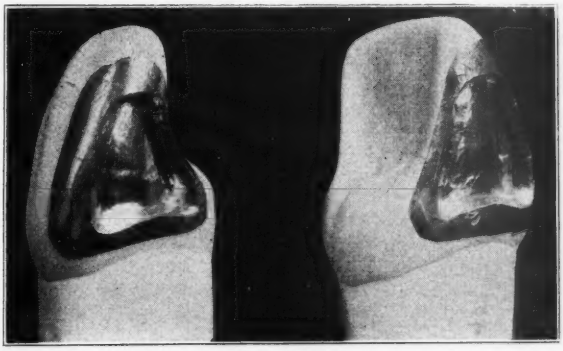

Fig. 14.—Lap of matrix at lingual aspect cut shorter than at any other part of matrix for easy removal from cavity.

The final cavosurface angle burnish is then given with a No. 6 E small burnisher by very careful burnishing away from the cavity at all points, carrying it over the tooth's surface, and definitely outlining the cavosurface angles. The gum camphor is removed with a No. 6 explorer, and hot wax is flowed into the matrix and chilled. Then, the matrix is removed, the wax allowing its removal without changing form. This wax is then burned out over a flame.

In extensive cavities at the gingival third on the labial or buccal surfaces, where fillings have been removed, more difficulty is met in forming a matrix. I use here the indirect-direct method, which consists of making a modeling compound impression of the prepared cavity. A model is made of this in a quick setting cement, and when it has hardened, the modeling compound is removed and trimmed, and the platinum matrix formed in the cavity of this model.

A piece of rubber dam is tied around the model and swaged in a water swager. This is then removed from the cement model, trimmed, placed in the tooth cavity and forced to placed with spunk.

The spunk is removed and a final swage with gum camphor is given, also a final burnishing of the cavosurface angles. This takes a few minutes longer, but, in most cases, saves considerable annoyance, and possibly some time in the end.

In forming the matrix for the porcelain, in the combination porcelain and gold inlay in Class 4 cavities of the upper teeth, the same technic is followed out for the cavities in proximal sur-

faces, extending the matrix over the area of the cavity in which the porcelain is to be placed.

COLOR, TOOTH FORM AND BAKING

After the study of the tooth's color has been made, a color a degree lighter is selected. One should always take into account the thickness of the porcelain at any given point of the inlay, for the reason that the thicker the body of any given color the denser the color, and, on the other hand, the thinner the body, the paler or lighter the color resulting. Thus, if we have, for example, extensive decay, necessitating greater mass

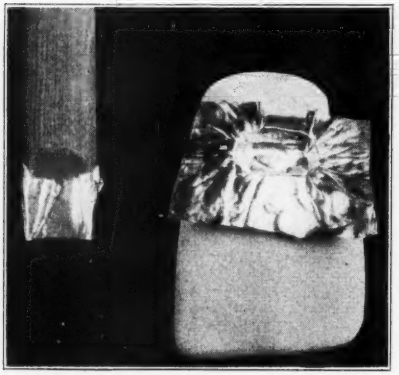

Fig. 15.—Platinum foil folded over orangewood stick that has been shaped to fit cavity; matrix as it appears when unfolded over labial surface ready for swaging.

in a deep-seated inlay, we should keep in mind varying the color by using a lighter shade for the thicker body of porcelain. It may be necessary to use two or three variations of shades and in some cases distinctly different colors. This is governed by the extent of the surface involved, gingivo-incisally, and the degree of the blend necessary for the case.

If the colors do not blend smoothly, the technic should be as follows: The porcelain is worked as dry as possible, into, first, the gingival part of the matrix and then the remaining colors are added toward the incisal as is necessary in the given areas, until the incisal part of the matrix is reached. They are not allowed to run together, until they are all placed. Then, a gentle vibration leaves the colors only slightly blended.

For a delicate blend, fewer colors should be used, the body being more moist, so that when the varying colors are placed and the matrix is vibrated,

Fig. 16.—Orangewood stick holding matrix in cavity while, with No. 2 burnisher, it is unfolded and burnished down over tooth surface.

they will intermingle to a greater degree, which gives a more constant as well as a delicate blend.

More accurate results can be obtained by using the carving knife to place the body, and a strip of white blotting paper to absorb any surplus moisture.

The flow of any color into another can be stopped at once by placing the blot-

ting paper on the body of the porcelain, placed in the matrix.

The form should be built up and carved to represent the form of the dentin in relation to that of the enamel, which is accomplished in from three to five bakes. The bakes should be only brought to a high biscuit, which gives translucency. Color, form and translucency are as nearly as possible those of the dentin.

The contouring of the inlay is now completed, with one or two colors, representing the enamel, and known as the enamel coat, which should be applied also with the carving spatula. This, when brought to a high glaze, will reflect all the underlying colors of the previous bakes, and if the tooth surface is copied as nearly as possible, there will be the same refraction of light, which is a great factor in producing harmony of color.

Fig. 17.—Proximal inlay with grooved walls for retention.

The color of the enamel is selected from the color of the incisal third of the tooth, which is usually of a gray, blue or green hue.

There are often found streaks of brown, yellow white or sometimes cloudy effects on the surface of the enamel and also faint checks of varying length and depth that have absorbed discoloration.

These discolorations can be very artistically reproduced on the surface of the inlay by laying a high fusing stain on the surface after the last high fusing bake. When the enamel is baked over this a staining effect is produced that will not wear off, like the oil stains that are painted on the surface.

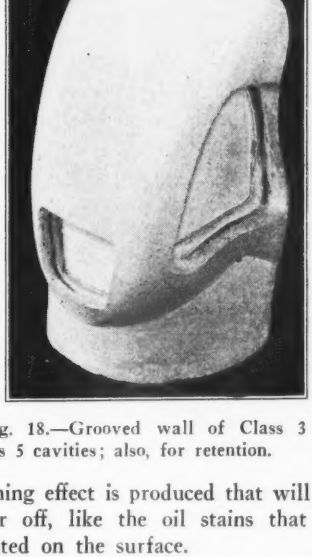

Fig. 18.—Grooved wall of Class 3 and Class 5 cavities; also, for retention.

This staining, combined with careful selection of body color, gives a beautiful and artistic result.

The building of contour and tooth form requires that the operator have at his command a thorough knowledge of dental anatomy, so that an inlay can

be made to represent the form of the surface of the tooth in the detail that is to be reproduced, and also that when the inlay is cemented to place, there will be the smallest amount of overhang at the cavosurface angle, and therefore only the slightest of finishing required to complete the operation.

REMOVAL OF THE MATRIX AND CEMENTATION

In removing the matrix, great care should be taken not to fracture the thin edges of the inlay in the least. If such an accident should happen, a new inlay should be made in all cases, as such an inlay is faulty and should not be cemented to place. The inlay is held firmly between the thumb and index finger of the left hand, while, with the matrix pliers, the matrix is gently pulled away from the edges of the inlay, the operator turning it in the fingers as he proceeds and never pulling the matrix from the body of the inlay toward the edge lest a fracture result.

In approximal cases, it is always best to adjust the separator in fitting and setting the inlay, to assure access.

The inlay now is fitted to the cavity and examined for color. The cavosurface angles are also examined for overhang. In case of overhang, the inlay is removed and held tightly between the thumb and finger of the left hand, while, with a three-quarter inch cuttlefish disk, this surplus is carefully smoothed off, and the inlay replaced in the cavity and tested, until all overhang is removed. A groove around the walls of the inlay should now be cut with a No. 39 Chayes stone, and a corresponding groove should be cut in the cavity wall with a No. xx very small inverted cone bur. (Figs. 17-18.)

The inlay should now be given the proper toilet and also should be dehydrated with alcohol and dried with warm air. The toilet of the cavity also is performed by first removing the remaining decay and as much of the discolored dentin as possible by the use of spoon excavators. The walls then are carefully gone over with a No. 5 or 6 hoe excavator, then dehydrated with alcohol and dried with warm air.

Cementation is an important step, especially as regards the permanency of any porcelain operation. In proximal surfaces, the white and light yellow cements should be used, but in the gingival surfaces, the deeper yellows can be used to some advantage.

There is no advantage in attempting to color any inlay by the use of colored cement. A cement that will not change the color of the tooth but will harmonize with it should be used.

I recommend the use of silicate cement to set all porcelain inlays, for the reason that when it crystallizes, it gives a denser mass than the regular oxyphosphate cement, and therefore it does not absorb the discolorations so readily, giving a more lasting quality to the color.

As the silicate cements are not adhesive, undercuts must be made in the inlay, also in the cavity walls, to anchor the inlay in the tooth properly.

The cement should be mixed on a cold slab, at a temperature of about 50 F., with a glass or an agate spatula. No metal instruments should come in contact in mixing or in placing the cements, to avoid discoloration from the metal.

Before starting the mix, instruments and all necessary things, such as celluloid strips, ligature and orangewood point, should be laid out, to avoid any unnecessary delay; for when the mix is completed, the cement should be placed and the inlay seated to place as soon as possible, and held tightly, for the reason

that, as soon as the cement starts to crystallize, it should not be disturbed.

This precaution will insure a denser mass of cement when crystallization is complete.

The amount of liquid should be from 2 to 4 mg., according to the size of the inlay. This makes a comparatively small mix, the advantage being that the consistency of the mix can be controlled much more easily by using a small amount. This is mixed quite thin, though it should have body enough to make a good dense mass when it sets. This can be learned only by clinical experience and should be worked out very carefully.

When the mix is complete, the cement is introduced into the cavity by a small pointed orangewood stick, then, by taking the inlay between the thumb and first finger and holding in this position, with the wood point, we fill the groove and cover over the wall surfaces with cement. Then, with the foil pliers, the inlay is inserted in the cavity and, with a fine explorer, it is seated.

In the proximal surfaces, a ligature is used to gently seat the inlay, and is drawn from the gingival to the incisal aspect to remove the surplus soft cement.

A celluloid strip is passed into the interproximal space, and brought definitely around the inlay, care being observed not to dislodge it in doing so.

This strip, which is held tightly, holds the seated inlay snugly in place. Pressure is maintained for about five minutes until primary crystallization has taken place.

On gingival surfaces, the inlay is rocked to place by the use of two orangewood points. The surplus cement should be removed with a cotten pellet to determine whether the inlay is properly seated. Great care is taken to avoid fracture. The inlay is held to place for five minutes with the orangewood points, and the surplus cement now can be trimmed away by a fine explorer.

The freshly cemented inlay should be coated with varnish and the patient instructed not to disturb it for at least twelve hours, when he should return, and the operation be finished.

Finishing consists of a simple operation when the inlay is made properly, requiring only removal of the overhanging cement.

On proximal surfaces, a fine cuttlefish strip is drawn over the gingival cavosurface angle a few times, and a cuttlefish disk is used in the engine to go over the lingual, labial and incisal cavosurface angles, disking down the edge of the inlay to the smooth surface of the tooth. On the gingival inlays, cuttlefish disks are used for smoothing and polishing, assuring a clean, finished operation.

The introduction of silicate cement for setting porcelain inlays has seen a marked advance in technic. It crystallizes into a much harder and denser mass than oxaphosphate cement and therefore does not absorb discolorations so readily, assuring greater permanency of color. It also affords a more translucent medium, which tends toward harmony in color.

ROENTGENOGRAPHICALLY NEGATIVE PULPLESS TEETH AS FOCI OF INFECTION: RESULTS OF QUANTITATIVE CULTURES*

By PAUL S. RHOADS, M.D., and GEORGE F. DICK, M.D., Chicago, Ill.

THE relation of dental sepsis to systemic disease is as well established as the principle of focal infection itself. Satisfactory roentgenograms, together with careful direct inspection of the teeth and tests for vitality, make an evaluation of the teeth as sources of infection less difficult than is the case with the other common foci. Yet there is a surprising lack of agreement as to which teeth are to be considered foci of infection. When films reveal extensive rarefaction at the root end or, on direct examination, one finds advanced pyorrhea with loose teeth, there is rarely any question that extraction is indicated.

Difficulty arises in deciding the fate of (1) pulpless teeth showing roentgenographically no or extremely little change at the root end: (2) root fragments left from previous attempts at extraction, which are roentgenographically negative: (3) so called "residual areas" of bone condensation or rarefaction at the site from which a tooth has been removed: (4) teeth which respond to the electric current and have only slight changes at the tip and about the shaft in the films.

This study was undertaken to throw light on the pathologic significance of of pulpless roentgenographically negative teeth. That this constitutes a major medical and dental problem may be appreciated from a short examination of recent publications. Haden[1] found 91 per cent of 500 persons at a pay dental clinic to have pulpless teeth, the majority of which had frank changes at the apex. Among 3,276 teeth studied by Tovell,[2] 1,600 were pulpless and 73 per cent of these previously treated teeth showed evidence of apical disease. Only 4 per cent of nontreated teeth gave evidence of periapical involvement. Ulrich[3] examined 1,350 pulpless teeth in patients who were ill and found that 83 per cent showed apical change in the roentgen-ray films. Of those artificially devitalized, 68 per cent had apical granulomas. In complete roentgen-ray examination of the mouth made by Moorehead[4] in a series of 332 patients suffering from chronic arthritis, 1,132 cases of periapical infection were found, 994, or 88 per cent, of which were around teeth that had been treated with various root-canal fillings. He found that the poorer classes had relatively

*From the Wallace R. Lane Fund and the John McCormick Institute.

1. Haden, R. L.: Incidence of Pulpless Teeth, J.A.D.A., 11:730 (Aug.) 1924.

2. Tovell, cited by Anderson, H. B., in chapter on oral sepsis in Tice, Frederick: Practice of Medicine, Hagerstown, Md.; W. F. Prior, Inc., 1927, p. 389.

3. Ulrich, H. L.: Blind Dental Abscess, J.A.M.A., 65:1619 (Nov. 6) 1915.

4. Moorehead, F. B.: Prevalence of Chronic Mouth Infections and Their Management, J.A.M.A., 67:845 (Sept. 16) 1916.

TABLE 1.—SUMMARY OF BACTERIOLOGIC STUDY OF TWENTY-NINE TEETH WITH FILLED ROOT-CANALS SHOWING NO APPRECIABLE CHANGE IN THE ROENTGENOGRAM

Case	Clinical Diagnosis	Description of Specimen	Bacterial Count	Clinical Result	Micro-Organisms Cultured	Animal Inoculations
1		Upper crowned second molar, canals well filled	1,847,000	Much improved, other teeth than those cultured were removed	Streptococcus viridans, pneumococcus, Streptococcus hemolyticus, Staphylococcus albus	Inoculated with pneumococcus: empyema, bronchopneumonia, suppurative pericarditis
	Severe arthritis for sixteen years	Lower crowned second molar, canal filling showed in only one root	9,836	Much improved, other teeth than those cultured were removed	Streptococcus viridans, pneumococcus, Staphylococcus albus	Inoculated with streptococcus viridans: arthritis
		Lower crowned second molar, canals filled	55,500	Much improved, other teeth than those cultured were removed	Streptococcus viridans, Staphylococcus albus, gram-negative bacilli	
2	Secondary anemia	Lower second bicuspid, filled root canal	6,000	No improvement	Streptococcus viridans, gram-negative and gram-positive bacilli, Staphylococcus albus	
3	Sciatic neuritis	Lower third molar, both canals filled; question of slight rarefaction at one root	1,470	Improved; had one definitely abscessed tooth also removed	Streptococcus viridans, Staphylococcus albus	
4	Hemorrhagic nephritis	Upper second bicuspid, filled canal	2,900	Improved; also had tonsillectomy, etc.	Streptococcus viridans, Staphylococcus albus, small gram-negative bacillus	
5	Duodenal ulcer, renal calculus	Upper first molar; only one canal filled	435,000	Improved; had other treatment	Streptococcus viridans, Staphylococcus albus	Inoculated with streptococcus viridans: enteritis

TABLE 1.—CONTINUED

Case	Clinical Diagnosis	Description of Specimen	Bacterial Count	Clinical Result	Micro-Organisms Cultured	Animal Inoculations
6	Proliferative spinal arthritis	Lower crowned first molar, filled root canals	700	Improved, other pulpless teeth removed	Streptococcus viridans, Staphylococcus albus	
						Inoculated with Streptococcus viridans: arthritis, pneumonia
		Lower second molar: question of minute change at one apex	347,000	Improved, other pulpless teeth removed	Streptococcus viridans, staphylococcus, one colony hemolytic streptococcus	Inoculated with Streptococcus viridans: osteomyelitis
						Inoculated with Streptococcus viridans: arthritis, paralysis of hind legs
		Upper first bicuspid, canal filling	1,500	Improved, other pulpless teeth removed	Staphylococcus albus, Streptococcus viridans	Inoculated with Streptococcus viridans: arthritis, periorbital and left ethmoid infection
7	Sciatic neuritis, secondary anemia	Lower first molar, canal filling	7,800,000	Improved, had other teeth removed	Streptococcus viridans, Staphylococcus albus	
		Lower first bicuspid, filled root canal	390		Streptococcus viridans	
8	Arthritis of knees, shoulders	Lower first molar, one canal filling extends through tip	117,000	Improved	Streptococcus viridans, Staphylococcus albus, gram-positive, diplococci (not pneumococcus), hemolytic streptococcus	Inoculated with hemolytic streptococcus: suppurative arthritis, osteomyelitis
9	Secondary anemia, chronic fatigue	First bicuspid, filled root canal	5,300	No improvement	Streptococcus viridans, staphylococcus, gram-positive bacilli	

TABLE 1.—CONTINUED

Case	Clinical Diagnosis	Description of Specimen	Bacterial Count	Clinical Result	Micro-Organisms Cultured	Animal Inoculations
10		Upper cental incisor, filled root canal	10,400	Improved, on regular ulcer management	Streptococcus viridans, diphtheroids, Staphylococcus albus	Inoculated with Streptococcus viridans: myositis, osteomyelitis, emaciation
	Duodenal ulcer, chronic nephritis	Upper central incisor, filled root canal	47,000	Improved, on regular ulcer management	Streptococcus viridans, Staphylococcus albus, diphtheroids	
		Upper second bicuspid, slight change in pericemental membrane all around root	29,000		Streptococcus viridans, Staphylococcus albus	
11	Mild arthritis, ethmoiditis	Upper first molar, one canal filled; question of minute change at tip of other root	120	Slight improvement of arthritis	Staphylococcus albus, gram-positive bacilli, Streptococcus viridans	
		Upper second bicuspid, canal filling	120	Slight improvement of arthritis	Staphylococcus albus, gram-positive bacilli, streptococcus viridans	
12	Continuous low fever, secondary anemia	Upper second bicuspid	1,600	Improved, much other treatment	Streptococcus viridans, Staphylococcus albus	
13	Encephalitis	Upper second molar, two good canal fillings	11,000,000	Improved, other teeth removed	Streptococcus viridans, Staphylococcus albus	Inoculated with Streptococcus viridans: marked emaciation, cloudy swelling of heart, kidneys, liver
14	Hyperthyroidism, cervical adenitis	Upper second bicuspid, canal filling goes through side of tooth, no rarefaction seen	2,600	Improved, had other treatment	Streptococcus viridans, Staphylococcus albus, large gram-negative bacillus	

TABLE 1.—CONCLUDED

Case	Clinical Diagnosis	Description of Specimen	Bacterial Count	Clinical Result	Micro-Organisms Cultured	Animal Inoculations
15		Lower second molar, one canal filling incomplete	10,600	Improved, other pulpless teeth removed	Streptococcus viridans, pneumococcus, gram-positive bacilli, Staphylococcus albus	
		Upper central incisor, canal filling	2,000	Improved, other pulpless teeth removed	Streptococcus viridans, Staphylococcus albus	
	Spinal arthritis	Lower second molar, one canal filling incomplete; question of slight change at this tip	17,000	Improved, other pulpless teeth removed	Streptococcus viridans, pneumococcus, hemolytic streptococcus, Staphylococcus albus	
		Lower first bicuspid, canal filling	184,300	Improved, other pulpless teeth removed	Streptococcus viridans, pneumococcus, Staphylococcus albus	
16	Neuritis	Upper first bicuspid, canal filling	4,800	Improved, removed frankly abscessed tooth also	Staphylococcus albus, Streptococcus viridans, gram-positive bacilli	
17	Sciatic neuritis	Lower first molar, filled root canals	21,500	Improved, other teeth removed	Streptococcus viridans, gram-positive bacilli	Inoculated with streptococcus viridans: died of acute intestinal obstruction; no other findings
18	Neuritis, colitis	Upper first bicuspid, canal filling	67,000	Improved, had other teeth removed	Streptococcus viridans, staphylococcus	

Average bacterial count, 759,574
Percentage with counts above 10,000, 51.7 per cent

fewer apical lesions than the well-to-do or middle classes. This, he thinks, is because the poor people usually have aching teeth removed. While not committing himself to the position that all pulpless teeth should be removed, he thinks they should never be retained in the face of systemic disease in which they are regarded as a possible focus. Duke,[5] in his study of 1,000 medical cases seen in consultation, found areas of bone absorption at the roots of 81 per cent of pulpless teeth. Of those having poorly filled root canals, 88 per cent gave roentgenographic evidence of granulomas. In those in which the canals were well filled, there was appreciable apical change in 52 per cent. Eustermann[6] examined dental films in 900 cases at the Mayo Clinic and found 2,099 teeth with dead pulps, 7 per cent of the number examined. Eighty per cent of the pulpless teeth had "some lesion inclusive of minute rarefaction, granuloma or cyst." At Cornell University, Gould[7] examined films of 325 students taken during routine physical examinations. Eighty-nine per cent had root-canal fillings, and 29 per cent of these pulpless teeth showed apical changes.

The figures just cited give some idea of the enormous numbers of root-canal fillings that have been placed in the past few years, and of the ultimate outcome regarding frank bone involvement. In the figures cited, 69.2 per cent of pulpless teeth in adults had roentgenographic evidence of periapical bone change. Assuming that root-canal filling is undertaken to preserve the teeth and conserve the patient's health, these figures would indicate that the procedure is unsuccessful in the hands of the majority of dentists.

Those who believe that pulpless teeth should be preserved until advanced apical disease is demonstrable by roentgen rays point out that, in rare instances, areas of decreased density at the apices of teeth clear up months or years after removal of poor root-canal fillings and retreatment, or root resection.[8] They point out that histologic sections of pulpless teeth often reveal healing changes with formation of connective tissue and "bonelike tissue" and assume that such evidences of regeneration make it unlikely that these teeth are foci of infection. Black[9] reported a series of cases in which there was no roentgen-ray evidence of disease at the time root-canal treatment was undertaken. Films of these pulpless teeth taken from six to eight years later revealed that only 9 per cent of those with good root-canal fillings had apical lesions, while 63 per cent of those with poor fillings showed definite apical absorption. No data as

5. Duke, W. W.: Oral Sepsis in Relationship to Systemic Disease, St. Louis, Mo.: C. V. Mosby Co., 1918.

6. Eustermann, M. F.: Roentgenographic and Clinical Findings in Teeth of Nine Hundred Patients, J.N.D.A., 19:257 (March) 1922.

7. Gould, A. G.: Symptomless Root Canal Filled Teeth, J.A.M.A. 90:1533 (May 12) 1928.

8. Hatton, E. H.: Bacterial and Histologic Findings After Present Day Root-Canal Treatment, D. Cosmos, 70:924 (Sept.) 1928; Histopathology of Apical Region of Teeth with Partly Filled Root-Canals, J.A.M.A., 77:1805 (Dec. 3) 1921; Regeneration of Apical Region After Treatment and Filling of Pulp Canals, J.A.D.A., 13:486 (April) 1926. Coolidge, E. D.: Pulp Pathology and Treatment Problems, J.A.D.A., 15:1623 (Sept.) 1928; Root Resection as Cure for Chronic Periapical Infection, ibid., 17:239 (Feb.) 1930. Blayney, J. R.: Biologic Aspect of Root Canal Therapy, D. Items Int., 49:681 (Sept.) 1927.

9. Black, A. D.: Clinical Studies of Pulp Treatment, J.A.D.A., 8:132 (Feb.) 1921.

to the clinical condition of the patient or the bacteriologic findings are given. He concludes that root-canal filling in competent hands is a justifiable procedure.

On the experimental side, data are exceedingly meager except for the convincing work of Haden.[10] He considered the total bacterial content of the area at the roots of teeth the best index of their disease-producing potentialities. He made quantitative cultures of 600 pulpless teeth which he considered roentgenographically negative in deep tubes of glucose-brain-agar. By his technic, 46.2 per cent of such teeth were found to have ten or more colonies to the tube. Four hundred vital teeth with negative roentgen-ray findings were cultured in the same way, as controls. This group had ten or more colonies to the tube in only 4.8 per cent. The percentage above this figure in a series of 500 pulpless teeth with positive roentgen-ray evidence of bone destruction was 62.8. Streptococci were the predominating organisms in all cultures. He considers pulpless roentgen-ray negative teeth practically as potent in causing systemic disease as those having frank destruction at the roots. It is interesting that 31.2 per cent of the teeth with definite roentgen-ray evidence of disease in his series had only a scanty growth of bacteria. Many instances of prompt improvement in systemic disease following removal of pulpless roentgen-ray negative teeth were cited, as well as an extensive series of animal inoculations in which typical lesions were produced with the organisms recovered from these teeth.

Our work differs from Haden's chiefly in the quantitative method used. The series is small, owing to the fact that the teeth studied were all from private patients. Many that were cultured are not recorded here because we wished to confine ourselves in the present communication to teeth in which there was no appreciable apical change in the roentgenogram. As we became more experienced in interpreting films, our criteria for roentgen-ray evidence of periapical disease became more strict, and therefore only those cultures are recorded in which both we and the dental surgeons who worked with us agreed that there were entirely negative roentgen-ray findings or changes so minute that one could not justifiably call them pathologic. To be considered roentgen-ray negative, the film of the tooth cultured had to reveal no absorption along the shaft of the tooth, and no rarefaction nor condensation in the bone surrounding the apex. Only teeth having root-canal fillings visible in the roentgenogram were used in the "pulpless" tooth series.

METHOD OF STUDY

The extractions were all performed by three or four operators with whom the technic had been carefully gone over, the majority being done by K. L. Thompson. One of us was present at nearly every operation. If we or the operator had the slightest suspicion that there was visible contamination of the root-end in removal, the culture was abandoned. The gum surrounding the tooth to be extracted was carefully treated with iodin and alcohol, after which rolls of sterile gauze were arranged about the tooth to secure as dry a field as possible. Under local anesthesia, the tooth was removed straight out from its socket. With sterile bone-cutting forceps, the root end was snipped

10. Haden, R. L.: Dental Infection and Systemic Disease, Philadelphia: Lea and Febiger, 1928.

TABLE 2.—SUMMARY OF BACTERIOLOGIC STUDY OF FOURTEEN NORMAL, ROENTGEN-RAY NEGATIVE TEETH

Case	Clinical Diagnosis	Description of Specimen	Bacterial Count	Micro-Organisms Cultured
1	Normal, tooth removed for bridge work	Lower bicuspid	700	Staphylococcus albus, Streptococcus viridans
2	Normal	Upper incisor, broken above gum line accidentally	20	Streptococcus viridans
3	Hyperthyroidism, teeth removed for plate following extraction of abscessed teeth	Upper central incisor	2,100	Streptococcus viridans, long gram-negative, branching threads
		Upper lateral incisor	820	Streptococcus viridans, long gram-negative, branching threads
		Upper lateral incisor	6,800	Streptococci not changing blood-agar
4	Normal, teeth removed for plate	Upper lateral incisor	1,250	Streptococcus viridans, hemolytic streptococci, gram-negative bacilli
		Upper central incisor	70	Streptococcus viridans, gram-negative bacilli
		Upper central incisor	880	Gram-negative bacilli, Streptococcus viridans, gram-positive bacilli
5	Arthritis, teeth removed for a plate after removal of several abscessed teeth	Upper first molar	300	Gram-positive bacilli, Staphylococcus albus
		Upper second molar	20	Gram-positive bacilli
		Upper third molar	360	Streptococcus viridans, gram-negative bacilli
		Upper first bicuspid	No growth	
6	Myocarditis	Lower incisor	4,150	Gram-negative bacilli, gram-negative spirilla, Streptococcus viridans
		Lower incisor	8,800	Streptococcus viridans, gram-negative spirilla, staphylococci, gram-negative bacilli

Average bacterial count, 1,876
Highest bacterial count, 8,800

off into sterile gauze, and was taken immediately to the laboratory. It was cultured by a method similar to that used in quantitative cultures of tonsils.[11] In a sterile mortar, the tip, together with a small amount of sand, was ground up in 10 c.c. of plain broth. One cubic centimeter of this dilution was added to 9 c.c. of broth to make a 1:100 dilution. One cubic centimeter of the latter was added to another tube containing 9 c.c. of broth to make a 1:1,000 dilution, and this process continued until a dilution of 1:1,000,000 was reached. One cubic centimeter amounts of the broth from the mortar and the tubes containing the dilutions were added to tubes containing 10 c.c. each of plain melted agar to which one c.c. of defibrinated sheep's blood had been added. After inoculation with the broth, the tubes of blood-agar were poured into Petri dishes and incubated forty-eight hours. Then, the number of bacteria in the root-tip cultured were estimated by counting the colonies in the various dilutions. The root tips were not weighed nor the bacterial count per gram estimated because the chief growth is at the tip of the tooth and has no relation to the total amount of root-end used in the culture.

In many instances, two series of plates were prepared and one made anaerobic by the method of Dick.[12] A layer of plain agar was poured over the blood-agar after the latter had cooled. When the plain agar was cool, melted paraffin was poured over it. Bacterial counts in the aerobic and anaerobic plates were so nearly the same that anaerobic cultures were discontinued. Qualitatively, the chief difference was that streptococci did not grow quite so abundantly in the anaerobic cultures and gram-negative bacilli and spirilla grew a little more abundantly.

A small series of animals were inoculated with streptococci from teeth in this series. Slants of blood-agar were inoculated with single colonies from the plates. Washings from a single slant were used to inoculate a tube containing 10 c.c. of plain broth, and 0.2 c.c. of a 24-hour broth culture was injected into the ear vein of a rabbit. At intervals of from two to four days, the inoculations were repeated, the dose being gradually increased each time until doses of from 5 to 10 c.c. were reached, unless the animal died earlier in the course of injections. It was thought that this method would simulate focal infection in man more closely than Rosenow's[13] method, in which 5 c.c. of a broth culture are given at one intravenous injection and the animal killed two or three days later.

RESULTS

The average bacterial count of cultures from the apices of twenty-nine roentgen-ray negative pulpless teeth was 759,574. A series of fourteen vital, healthy roentgen-ray negative teeth cultured in precisely the same manner had an average bacterial count of 1,876. The difficulties of getting uncontaminated cultures from the root-ends of teeth are appreciated. Some of the healthy "control" teeth may have had bacteria growing at their roots; but, in all prob-

11. Rhoads, P. S., and Dick, G. F.: Efficacy of Tonsillectomy for Removal of Focal Infection, J.A.M.A., 91:1149 (Oct. 20) 1928.

12. Dick, G. F.: Plate Method for Isolating Anaerobes, J. Infect. Dis., 23:578 (Dec.) 1918.

13. Rosenow, E. C.: Studies on Elective Localization, J. D. Res., 1:205, 1919.

ability, the growth obtained represented unavoidable contamination. The difference in the counts of the two series is too great to be credited to chance contamination.

Sixteen of the pulpless teeth (51.7 per cent) had counts of 10,000 or more; at least, 1,000 higher than the highest in the control series. This approximates the results of Haden, who found 46.2 per cent of roentgenographic negative devitalized teeth to have counts above that arbitrarily selected as "heavy growth," while only 4.8 per cent of his normal control teeth had counts above this figure.

In the present study, one cannot draw conclusions from clinical results because only in a few instances was the single extraction the only measure taken to relieve the symptoms of systemic disease. Practically all of our patients experience some improvement. In cases 1, 6, 7, 8, 15, 17 and 18, administration of sodium salicylate and, in some instances, rest in bed were about the only other things prescribed besides extraction of pulpless teeth, and the improvement was definite. The assumption seems justified that extraction of the root canal filled teeth was chiefly responsible for the clinical result in these cases.

Green-forming cocci were cultured from the pulpless teeth in every instance. In all but two, they were the predominating organisms. Several green colonies from each culture were tested on inulin, and those fermenting inulin were tested for bile solubility. In six instances, inulin-fermenting, bile-soluble diplococci were identified. Three other strains of green-forming cocci fermented inulin, but were not bile soluble. The other organisms frequently found were *Staphylococcus albus,* gram-negative bacilli and hemolytic streptococci. Occasionally, gram-positive bacilli and gram-negative spirilla were found.

CONCLUSION

The average bacterial count of the twenty-nine pulpless, roentgen-ray negative teeth was 759,574, while the average count of the healthy controls was 1,876. Of the pulpless teeth, 51.7 per cent had higher bacterial counts than any of the controls. This corresponds closely to Haden's results in quantitative cultures of teeth of the same type. When only 68.2 per cent of teeth showing definite areas of translucence at the tip, usually interpreted as "apical abscess," have similarly high bacterial counts, it is evident that pulpless teeth showing no change at the tip in roentgenograms are almost as important as sources of infection as those showing definite disease roentgenographically.

That a high percentage of pulpless teeth eventually show roentgen-ray evidence of bone change at the apex, even though there is no evidence of bone destruction at the time that the root canals are filled, seems a fair assumption. The statistics of other workers covering the roentgenographic examination of many hundreds of teeth, cited earlier in this paper, reveal that from 80 to 90 per cent of the mouths of adults contain root-canal filled teeth. In the series cited, an average of 69.5 per cent of these pulpless teeth showed roentgen-ray evidence of periapical infection.

In view of the results of quantitative cultures found by Haden and confirmed by us, and the figures just cited, it seems justifiable to regard all pulpless teeth as probable foci of infection whether they show apical changes in the roentgenograms or not. Certainly, this position should be taken in the presence of systemic disease of a type usually associated with focal infection.

CONSTRUCTION OF PARTIAL DENTURES, CONSIDERING BALANCED OCCLUSION AND FACTORS IN A SUCCESSFUL AND SERVICEABLE CASE*

By LOREN D. SAYRE, D.D.S., Chicago, Ill.

THE subject of partial dentures has again reached a more or less quiescent state after a ten-year period of new technics, new articulators and new materials, each of which has been brought to our attention rather forcibly in many ways, the claims of each exponent being often so broad and definite that many have wondered whether they should discard the present technic and materials, and if so, which way to turn or which technic to embrace. The question of attachments, baseplates, impression materials, cast materials, articulators and teeth have so absorbed our attention that, in many cases, sight has been lost of the main issue, it having been subordinated to a technic or material.

Our problems have not changed, and today the fundamentals for a successful and serviceable case are the same as they have always been. Our knowledge of pathology, histology and anatomy have improved, giving us a keener appreciation of the requirements of serviceable dentures, while, at the same time, our knowledge of physical properties of material and the handling of these materials has improved, making it possible to achieve better results, and frequently with less effort.

Much of the advancement made in the past few years in the construction of serviceable partial dentures is not due to new technics involved in the actual building of the dentures, the method of securing the impressions or the materials from which they are constructed, but rather to the fact that more serious minded men have interested themselves in the causative factors in their failures and have worked out adequate methods of overcoming such conditions.

The partial dentures being constructed today are so far superior to the partial dentures of twenty years ago that there can hardly be a comparison made between them. On the other hand, the men constructing partial dentures today are far less satisfied with the results of their efforts than were the men a quarter of a century ago. While technics of construction are not to be depreciated or minimized, the main interest and advancement has been more in determining the fundamental principles of condylar, maxillomandibular and cusp relationship, with the conservation of hard and soft structure resultant from the application of these principles.

Much credit is due the periodontist, the orthodontist and the full denture man. All of these have been exceptionally active in solving the problems of malocclusion, and we partial denture men have benefited to a great extent by

*Read before the Section on Partial Dentures, Crown and Bridge at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

their findings, giving their ideas practical application in our own fields of work.

The partial denture worker of today, owing to the work of the periodontist, orthodontist and full denture man, have a definite objective, an ideal of just what constitutes the conditions necessary for harmonious relationship of teeth and jaws, producing an efficient milling and masticating organ in the mouth. We are also indebted to the pathologists for a knowledge of that chain of events which is responsible for failure to attain the ideal in the dentures constructed, and for our ability to foresee the resulting pathologic conditions when we establish or perpetuate an inharmonious, unbalanced occlusal condition in the mouth.

I do not intend to touch on any particular technic, material or articulator: rather, I wish to bring out some of the fundamentals which can be applied to almost any technic, material or articulator used, and the fact that unless full consideration is given these fundamentals, a successful and serviceable restoration cannot result. While most of this is generally known and has been and is being taught in our schools, there still seems to be an appalling disregard for these success-insuring fundamentals.

Starting at the beginning of all partial denture work, our first duty to the patient is not to convince him that he needs a partial denture at all, but to convince him that the condition of his mouth is such that not only is he unable to properly masticate his food and is thereby injuring his health in that respect but also that, by neglecting the present condition, he is merely aiding Nature in destructive changes as far as the remaining teeth and soft tissues are concerned. Not only must this be brought to his attention but another angle also must be brought out, that of esthetics. He must be shown that not only the mouth itself but also the entire facial contour is radically changed owing to the loss of several teeth and closure of the bite, resulting in a forward and upward movement of the chin, laxness and furrowing of the facial muscles, and frequently a condylar change which adversely affects the sense of hearing. After these have been brought to the attention of the patient, the partial denture is treated not as a commodity but as therapeutic means to restore lost organs and function as well as to prevent, as far as possible, the development of pathologic conditions.

Without doubt, one of the most important steps in the construction of any partial denture is mouth preparation, placing the mouth in such a condition that it is possible for it to function properly as far as the movements of the mandible during function are concerned.

The degree of success with which a mouth as an organ can function is in direct relationship to and dependent on the occlusion of the teeth. The position, number and condition of, and the relationship that exists between, the remaining natural teeth determine the possibility of constructing a partial denture that will function properly.

To make any partial denture without first seeing that the remaining natural teeth can function properly as far as centric, lateral and protrusive movements are concerned is to perpetuate a trauma and introduce into that mouth new conditions that tend toward destruction of both hard and soft tissues.

This means that dressing down of interfering points of opposing teeth that prevent the free and normal mandibular movements must be done. Frequently, when elongated, malalined and rotated teeth are present and cutting these down

would be impractical, other means must be employed, and while we at all times should be conservative, there should be no hesitation in removing teeth which will prevent, if retained, the construction of a mechanically correct denture assuring a balanced occlusion. By careful planning, by means of study casts and careful execution in the mouth, it is possible to establish such a balanced occlusion. Because of uneven occlusal wear, abrasion, lowered resistance of the patient, previous extensive absorption or destruction of bony substance due to disease or extraction, there is frequently found a sufficient change in position of the remaining natural teeth to produce trauma. Usually, the greater the number of natural teeth missing, the greater the change of position noted in the remaining natural teeth, necessitating not only the cutting down of interfering points or surfaces, but frequently the building up of occlusal surfaces to restore a harmonious occlusal plane.

However occlusal balance is established, whether by grinding down interfering areas or by building up deficient areas, a harmonious relationship and freedom of all the mandibular movements must be established and thereafter maintained in order to render the greatest possible service to the patient.

Inharmonious cusp relationship is not always detected by the cursory examination of the mouth and teeth, such conditions frequently passing unnoticed until called to the attention by the patient's complaint of tenderness and pain. Before serious damage has resulted to the tissues, these interfering points can usually be located by means of carbon paper used both in the mouth and upon mounted study casts. These casts must, of course, be mounted upon an articulator capable of reproducing the movements of the mandible as nearly as possible. By careful study and observation, these interfering points and surfaces are detected and, by dressing down, they can be corrected.

Secondly, after damage has been occasioned to the soft tissues, an inflamed and hypertrophied area is usually observed, frequently with lost contact if there be approximating teeth, or a change of position of a tooth or teeth, either tipped, rotated or forced buccally or lingually. More often than not, the particular tooth involved or the whole segment of the arch will be tender to pressure.

The relief of such a condition by dressing down of interfering points, permitting the proper movements of the mandible, with an equal distribution of occlusal stress over all the remaining natural teeth that are in occlusion, is usually followed by rapid recovery in these areas and, by maintenance of balanced occlusion followed by strict cleanliness, will free the patient of pain and irritation as well as improve the function of the entire masticating machine.

Summing up mouth preparation in the construction of a partial denture, we can say that the teeth that remain in the arches, as well as the soft tissues, must be free from pathologic conditions, and that there must be proper occlusion established, permitting a normal movement of the mandible in its excursions during function.

Balanced occlusion has been spoken of so far only in relationship to the natural teeth. After balanced occlusion is established and maintained, it is equally necessary that the artificial substitutes for the missing teeth bear the same relationship to each other, for it is possible to establish inharmonious cusp relationship with the artificial teeth that produces damage equal to or greater than the original cusp trauma of the natural teeth.

Since the natural teeth or their substitutes are the only means of retaining and maintaining the correct relationship of the mandible and maxilla as well as the condylar relationship in the glenoid fossae, unless these relationships are developed and maintained failure is a certain result.

Development of balanced occlusion is purely a mechanical application of our knowledge, and this must be done in a manner that will aid in the physiologic function of the correlated parts.

In order to maintain balanced occlusion in partial denture cases (1) adequate occlusal rests, for which accommodation must be made, should in a large percentage of cases be used; (2) a sufficiently large area must be covered by the baseplate in order that the stress of occlusion and mastication shall have proper resistance and distribution without undue absorption; (3) proper anatomic tooth form must be developed so that food, after being crushed, will have sufficiently developed flood gates to permit it to escape easily from the occlusal surfaces, and (4) no forces exerted by clasps should be left unopposed, as otherwise there is a shifting of the clasped tooth in the direction of the least force, allowing a movement of the denture base which destroys the occlusal balance.

When the occlusal balance has been destroyed or lost from violation of any of the foregoing fundamentals, these conditions should be immediately corrected. In order to accomplish this, the patient must come in for frequent examination and prophylactic care, and any changes that have occurred from the original relationship established must be corrected by whatever means are necessary. Frequently, a small amount of grinding or reduction of cusp height, either of the natural or the artificial teeth, is all that is necessary; but, more often, it will be necessary to rebase some area or the entire denture to compensate for absorption. This not only restores the occlusion, relieving the natural remaining teeth of the burden of receiving the greater share of the occlusal stress, which results in an overfunctioning of these tissues, with a consequent breaking down, but also restores the distribution and resistance to stress so necessary for a balanced occlusion.

Among a large percentage of dentists and the laity, at the present time, partial dentures are considered a temporary appliance, utilized in that interval between bridgework and full dentures. After the examination of a great number of average partial denture restorations in average patients, the reason for such a feeling is readily seen. As a rule, esthetics has been given careful attention, and retention is usually adequate at the time the denture is placed, while the comfort afforded varies with the temperament and tolerance of the patient, but scant provision has been made for the one important condition that permits function, assists balance and maintains stability, efficiency and comfort. I refer to balanced occlusion, on which success depends.

According to Prothero, any partial denture, to be successful, must fulfil three requirements: esthetics, comfort and utility. These vary according to the individual and in the order of their importance. Esthetics, with the artificial teeth which we now have to select from, is not difficult to attain. If the operator's eye is trained to form and color, the matter of selection and arrangement is comparatively easy. Comfort and utility are more difficult to obtain and maintain, there being a number of conditions on which these depend, the requirements for one, however, to a great extent satisfying the

requirements of the other. In order to have utility, balanced occlusion is absolutely necessary, with proper occlusal form of the teeth to effect a milling process during mastication.

Comfort depends on retention to a great extent, and while I do not intend going into the subject of retention in any great detail, I shall mention it as far as it has to do with the comfort of the partial denture. Primarily, all we require in the way of retention is that the denture be held with certainty, giving the patient a feeling of confidence during the movements of the mandible in mastication as well as movements of the facial muscles and tongue in talking, laughing, etc. Any movement of the artificial teeth and denture base for any reason at all is immediately transmitted to the natural teeth to which the denture is attached in the form of leverage force.

This leverage force is frequently confused with overload, and any unnatural leverage force exerted against any tooth, if continued, will sooner or later result in a loss of the tooth. The reaction of a tooth or teeth to trauma is not so much on the amount of force exerted as on the resistance of the tissues involved and the direction of the force applied. The means of retention used therefore must be positive and constructed in such a manner that there be no leverage force exerted or any forces left unreciprocated, as otherwise malocclusion will soon be established by the movement of the tooth affected as well as of the artificial teeth attached to it. Stimulation of the tissues on this account is first brought about by overfunction up to a certain point, when the tissues become irritated and inflamed and, owing to the lowered resistance of the soft tissue, bacterial invasion takes place, with the resultant breaking down of soft tissue and pocket formation, frequently ending in the complete exfoliation of the tooth.

In order, then, to have a comfortable denture and avoid tissue trauma, the retention must be so applied as to act not only as a retention agent but in the nature of a splint as well, holding the anchor tooth in its proper position. The distribution and direction of the occlusal stress applied must not exceed the tolerance of the underlying supporting tissue, and, in accomplishing this, not only must the occlusal stress be considered but also the area covered by the baseplate. The present tendency appears to be the reduction in the size of the baseplate, little distinction being made between soft tissue-bearing appliances and tooth-bearing appliances. When too small an area is covered by the baseplate for the amount and direction of applied stress, a gradual pressure absorption immediately begins, resulting in loss of occlusion and transference of a large share of the forces exerted to the remaining natural teeth, with a consequent overload and damage to them.

The problem of retention is immeasurably simplified by having balanced occlusion, which allows occlusal contact in any of the possible positions of the mandible, tending to keep the denture base seated in contact with the soft tissue and consequently lessening the strain on the attached natural teeth. In many instances, when balanced occlusion is maintained, the retention appliances can be entirely removed and the denture base remains firmly seated during function.

So far, only cases requiring grinding down of interference in cusp relationship have been spoken of. These usually are cases in which intermittent teeth are missing and there is a normal condylar relationship. There is another class of cases in which, owing to extensive ex-

traction of the posterior teeth or extensive movement of the remaining natural teeth, there has resulted a loss not only of the normal cusp relationship but of the condylar relationship as well. This is manifested by the common term "loss of the bite," with a forward and upward movement of the mandible and a thinning out of the meniscus due to the backward thrust of the condyle heads. Such a condition, when extreme, is often associated with interference in the sense of hearing because of the pressure exerted against the canal of the middle ear.

In such cases, we have two alternatives: the dentures are constructed either to perpetuate the existing deformity or establish a new relationship between the arches approaching our idea of the normal. Which is done depends on the existing mouth conditions, the judgment of the operator and the age and temperament of the patient.

Another condition which requires the so-called "opening of the bite" arises where intermittent missing teeth are being replaced. This requires the building up of occlusal surfaces and incisal edges by means of large fillings and crowns. Regardless of how well such work is done, there is always a grave possibility of damage to both pulp and gingival tissues from preparation and restoration. The benefits of such procedures must be weighed against the danger that arises and damage that is done in reestablishing as nearly as possible the original temporomandibular relationship.

In practically all of the above mentioned cases, there is usually some pathologic condition of the soft tissues surrounding the roots of the remaining natural teeth, overfunctioning in some areas due to too great a stress, or loss of tone of the tissues due to lack of stress or exercise in other areas. In either case, if carried to extremes, bacterial invasion will eventually result, owing to a loss of tone and resistance of the soft tissues. If these conditions have not progressed too far and proper cusp relationship has been established with an equal distribution of stress, a rapid improvement usually results.

One other class of cases in which the temporomandibular articulation has been considerably altered are those which present an excessive uniform occlusal wear or abrasion. As a rule, these are unassociated with periodontal trouble and they can rarely be classed as traumatic occlusion cases. The occlusal and incisal wear has progressed in such a manner that a balanced occlusion is perfected, and these occlusal surfaces present practically no cusps, being worn smooth and presenting a continuous unbroken contact the extent of the entire arch.

In the construction of partial dentures for such a case, when excessive abrasion has proceeded to a point where it is practically impossible to construct a partial denture without building up the occlusion, care must be exercised to prevent pulp involvement during the preparations necessary. These restorations are necessarily extensive, involving practically all of the natural teeth remaining in the arches, and the possibilities of error are many.

These extreme cases, which absolutely require the raising of the occlusal surfaces to correct the occlusion as well as facial deformities, and rare instances in which an effort is made to correct the impairment of hearing, are fortunately infrequent in comparison to the ordinary cases in which the temporomandibular joint is not grossly involved and balanced occlusion can be established by slight reduction of interfering points or areas.

It is my experience that we are much more successful in building partial dentures to existing condylar relationship if balanced occlusion can be obtained, rather than in attempting to establish a new condylar relationship by opening the bite and arbitrarily establishing a new occlusal plane and cusp relationship, unless the relationships are so hopelessly lost that an excessive or prohibitive amount of grinding would be necessary. Particularly is this true when the overbite is such in the anterior teeth that the amount of reduction of the incisal edges of the lower incisors would not only ruin these esthetically, but would also necessitate the complete removal of the incisal enamel and even part of the dentin in extreme cases. Such cases obviously demand the raising of the occlusal surfaces and opening of the bite and placing of the mandible in as nearly correct relationship as possible, and then maintaining this relationship by means of the individual restorations, by crowns, bridges or inlays, as well as the occlusal relationship of the artificial teeth of the partial dentures.

In the construction of some partial dentures, the principles involved in full denture construction can be applied. This is true when all of the posterior teeth are being replaced, but when there are intermittent teeth present, the bite is established and the relationship existing between the remaining natural teeth can be changed only by altering the occlusal form.

The anatomic articulator does not play so important a rôle in partial denture work as it does in full denture construction because, in partial denture construction, the relationship that exists between the arches is determined by the remaining natural teeth, and while we should not disregard the advantages of making use of an instrument that closely approximates the movements of the mandible, the final occlusal adjustments must be made in the mouth by means of carbon paper and fine grit stones, not only on the artificial teeth but on the natural teeth as well. This is done not only at the time the partial denture is delivered to the patient, but also after the denture has been worn from twenty-four to forty-eight hours. Frequently there will be movements noted during mastication, acting in interference, which cannot be detected when the denture is at first introduced. Then, at periodical intervals, the patient should come in for examination, adjustment and prophylactic care.

In summarizing the foregoing fundamentals, allow me to point out a few of the important factors in producing partial dentures which are satisfactory and serviceable.

SUMMARY

1. Technics or materials should not be placed before the main issue, the construction of an appliance that is used more as a remedy to correct present ills and prevent future ills than as a means of esthetic restoration.

2. One of the most important steps considered in the construction of a case is proper mouth preparation; for the degree of success of our efforts is governed by the cusp relationship of the natural teeth as well as of artificial teeth used as substitutes.

3. There are two means of establishing proper occlusion of the remaining natural teeth: the dressing down of interfering points or the building up of the occlusal areas with crowns or inlays when the bite is excessively closed. In most cases, the former is the more practical.

4. Balanced occlusion must be main-

tained after once being established by rebasing or dressing down interfering points. Examinations should be made periodically.

5. Comfort and stability are greatly aided by balanced occlusion. Retentive appliances and forces can be greatly reduced if balanced occlusion is maintained.

6. Adjustable articulators do not play so important a part in partial denture construction as in full denture work. Final adjustment must be made in the mouth after the denture has been worn from twenty-four to forty-eight hours.

CLINICAL AND ROENTGENOGRAPHIC MANIFESTATIONS OF ATROPHIC CHANGES IN THE JAWS; ENDOCRINE AND VITAMIN FACTORS IN THE PRACTICE OF PROSTHODONTIA

By FRANK H. McKEVITT, D.D.S., San Francisco, Calif.

THE title, "Clinical and Roentgenographic Manifestations of Atrophic Changes in the Jaws; Endocrine and Vitamin Factors in the Practice of Prosthodontia," is intended to apply solely to clinical and roentgenographic findings that may be attributed to these disturbances. It is well known that a scientific discussion of this topic will involve not only clinical findings, but also elaborate chemical, laboratory and pharmacologic tests, differential diagnoses, case histories, a résumé of calcium magnesium and oxygen metabolism rates, blood counts and urinalyses.

One of the primary purposes of these tests in man, as it pertains to the topic, is to determine the density or lack of density of bone tissue as a diagnostic factor. Laboratory investigations into the antemortem and postmortem calcium-phosphorus structure of the bones of experimental animals have been fruitful. We are now beginning to understand the value of sunlight, cod-liver oil and ultraviolet rays, and the part they play in building bone tissue. I believe that this statement will be authenticated by the works of McCollum, Marshall, Howe and a host of others, the endocrine phase having been introduced more recently by such observers as Reese[1] and Key.[2] These newer sciences are rapidly being forged into an indissoluble link, particularly where the study of calcium metabolism is concerned.

To quote Reese:

> In the present status of our knowledge, there is a tendency to admit that almost all the endocrine glands exert an influence on the growth, on the formative processes of structural integrity, on the metabolism, and, finally, on the biochemical functions of cells or cell complexes. . . . Further investigation in close cooperation between the clinic and laboratory has shed more light on the actions of the endocrine glands, resulting in the determination of their secretory products, called

*Read before the Section on Full Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

1. Reese, H. H.: Significance of Endocrine and Vitamin Deficiencies as Etiologic Factors in Dental Abnormalities, J.A.D.A., 17: 2198 (Dec.) 1930.

2. Key, J. A.: Factors in Atrophy of Bone, J.A.D.A., 17:1660 (Sept.) 1930.

hormones. We speak now of a hyperfunctional and hypofunctional activity of the gland and support our clinical findings with special chemical and pharmacologic tests.

To arraign faulty diet as the most important factor in progressive destruction of the teeth, especially of the enamel, is unjustified, because improper food is not the exciting cause. Probably, the diminution of the utilizing power of the body brought on by a hormonic imbalance of the endocrine glands is a predisposing cause.

Discussing hyperparathyroidism as one of the causes of generalized atrophy, Key says:

It is now well known that the internal

Fig. 1.—Normal mouth.

secretion derived from the parathyroid glands has the capacity of raising the level of the blood calcium. . . . Consequently, with long-continued hyperactivity of these glands and the constant maintenance of an abnormally high blood calcium, there is a definite tendency to withdrawal of calcium from the bones. . . . Many clinical cases have been observed in which the presence of adenomas of the parathyroid glands was accompanied by generalized osteoporosis, bone cysts or giant-cell tumors. The exact relation between the hyperactivity of the glands and the production of local bone lesions has not yet been worked out, but clinical evidence is accumulating which seems to indicate that it may be a definite causative factor.

Discussing hypoparathyroidism in a paper entitled "Relationship Between Calcium Metabolism and Endocrine Dysfunction," read before the San Francisco Society of Exodontists, Ralph Reynolds said:

In cases of hypercalcemic bone, it seems probable that we are confronted with retention of calcium and phosphorus with hypercalcification. Greenwald demonstrated this retention after parathyroidectomy in dogs. According to many observers, there appears to be a close relation between hypoparathyroidism and abnormal calcification such as occurs in Paget's disease, juvenile sclerosis, renal sclerosis, otosclerosis, etc. The association of a low serum calcium and low calcium excretion in otosclerosis has been frequently observed by otologists. The occurrence of cataracts in parathyroid tetany in human beings and in experimental animals has been noted by many observers.

Told with the authority and reserve of these scientific workers in this field and coming from a vantage point from which to view their own findings and review similar work of others, it may be accepted as proved that the parathyroids, acting with other endocrine glands as an integral system, are the regulators of calcium metabolism and that a hormonic imbalance of the parathyroids affects the deposition and withdrawal of calcium from the skeleton, which these writers recognize as the storehouse of this material. The purpose of this paper is to attempt to link the foregoing scientific facts with clinical and roentgenographic manifestations of atrophic changes in the jaws as they are revealed by casts and roentgenograms and to try to explain the cause of failures of artificial dentures to prove satisfactory as a result of these changes.

A new impetus has been given this study by a novel construction placed

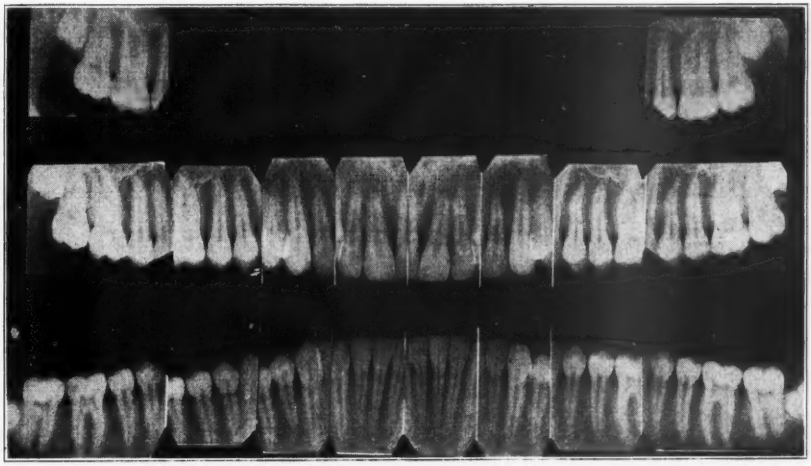

Fig. 2.—Normal alveolar bone in boy, aged 16.

Fig. 3.—Hypocalcemic bone in child, aged 15.

on the interpretation of McCormack[3] of dental alveolar roentgenograms and their bearing on bone densities. It is with these bone changes in the form of atrophy and hypertrophy of the alveolar process as they are clinically and roentgenographically revealed, that we, as prosthodontists, no less than the other practitioners of dental art and science, are concerned.

Fortunately for dental investigators, there is hardly a disturbance of the entire skeletal structure that cannot be recognized within the small area encompassed by the teeth and jaws. These range from fractures, dislocations, etc., to atrophy and hypertrophy, the many ramifications of which are without doubt the result of vitamin and endocrine deficiencies.

THE ROENTGENOGRAM

Roentgenographic manifestations of endocrine and vitamin deficiencies of the teeth and jaws are reflected in the appearance of alveolar bone trabeculae, the density of their contents and the color tone of the roentgenogram. More significance should be attached to the morphologic appearance of the trabeculae and to the clinical findings than to color tones as an index to bone densities, because of the variability of roentgenographic technic whether standardized or nonstandardized.

Fig. 4.—Hypocalcified bone in child whose parents were both edentulous before age of 50. Care of the mouth was scrupulous.

3. McCormack, F. W.: Plea for Standardized Technic for Oral Radiography, with Illustrated Classification of Findings and Their Verified Interpretations. J. D. Res., 2:467 (Sept.) 1920.

Surgical procedures have verified roentgenographic indications. A further check involved the construction of artificial dentures for these cases and the observance of their stability over a period of ten years. The pictures used, which were from every-day practice, are examples of a standardized technic which involves accurate angulation, timing, exposing and development of films.

This gives the entire mass its characteristic appearance of radiolucency; which suggests a possible nutritional disturbance and endocrine imbalance. When operated on in the removal of teeth and the preparation of the ridges for artificial dentures, it yields readily to instrumentation. Because of its mineral impoverishment, it offers little resistance to the passage of the light ray and the film records a dark color tone.

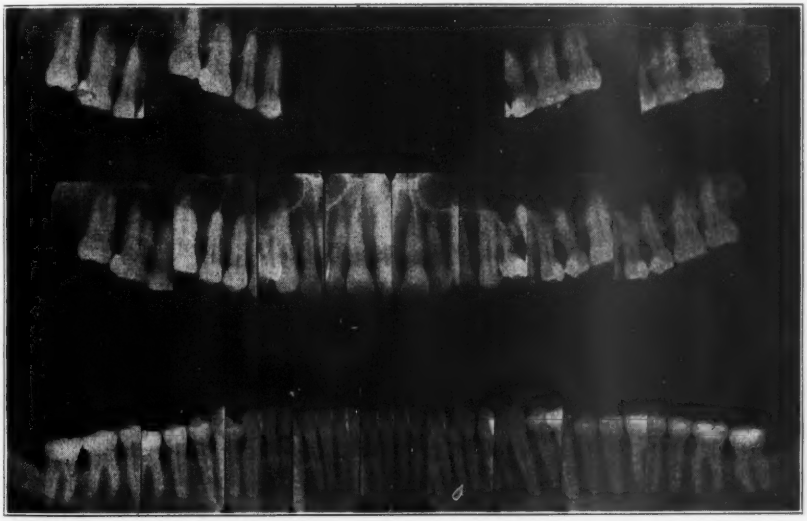

Fig. 5.—Hypocalcemic bone condition described sometimes as "generalized atrophy" (Key) or as "horizontal atrophy" (Becks), but called by the profession pyorrhea.

ROENTGENOGRAPHIC APPEARANCE OF HYPERCALCEMIC AND HYPOCALCEMIC BONE

The term "radiolucent" adequately describes the general appearance of hypocalcemic alveolar bone in the roentgenogram. An examination of the trabeculae as structural units discloses a whitish lacelike network, the calcium content recording much darker than the framework surrounding it. This bone type lends itself readily to atrophic changes, and offers an unfavorable base for artificial dentures.

The term radiopaque aptly describes hypercalcemic alveolar bone when viewed in the roentgenogram. An examination of its trabeculae as structural units reveals a heavier and denser calcium content. The trabeculae appear smaller and well filled when contrasted with the trabeculae in hypocalcemic

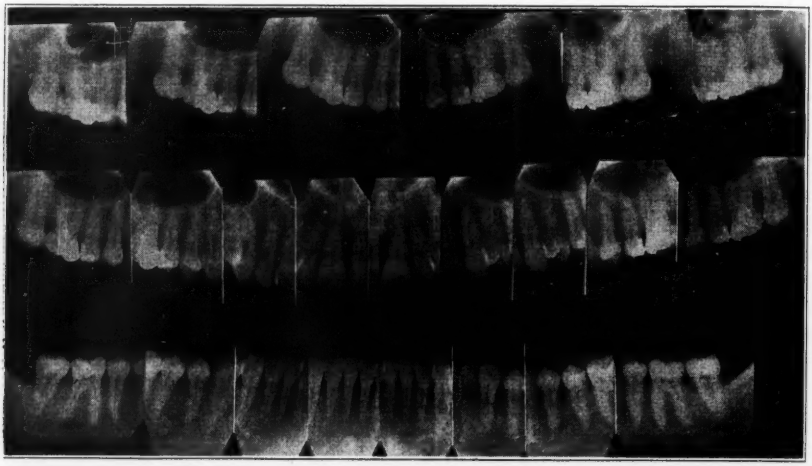

Fig. 6.—Nearly normal bone case in Italian, aged 36, on diet rich in calcium.

Fig. 7—Hypercalcemic bone in patient, aged 38; showing closely knit trabeculae and teeth comparatively free from caries.

Fig. 8.—Hypercalcemic bone in patient, aged 28; a case of retention of calcium and phosphorus with hypercalcification.

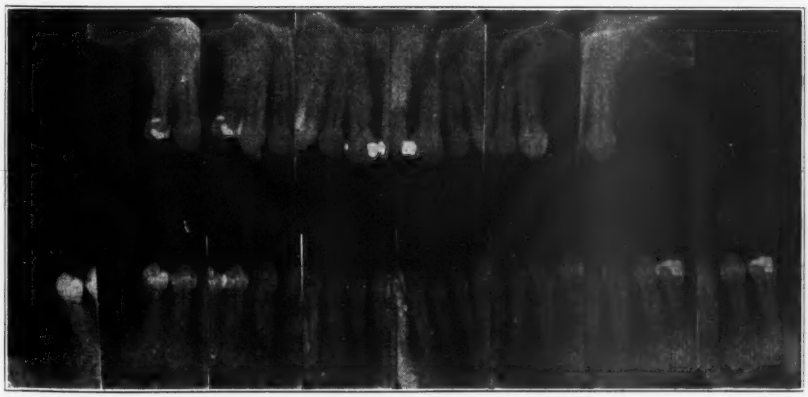

Fig. 9.—Hypercementosis in hypocalcemic bone.

bone, which appear empty. This richer mineral composition impedes the progress of the light ray, and the finished picture records a light color tone. When operated on in the removal of teeth and the surgical preparation of the ridges for artificial dentures, it demands dextrous handling to deliver teeth without breakage. This type of bone is more resistant to atrophic changes than the hypocalcemic type and affords a favorable base for artificial dentures.

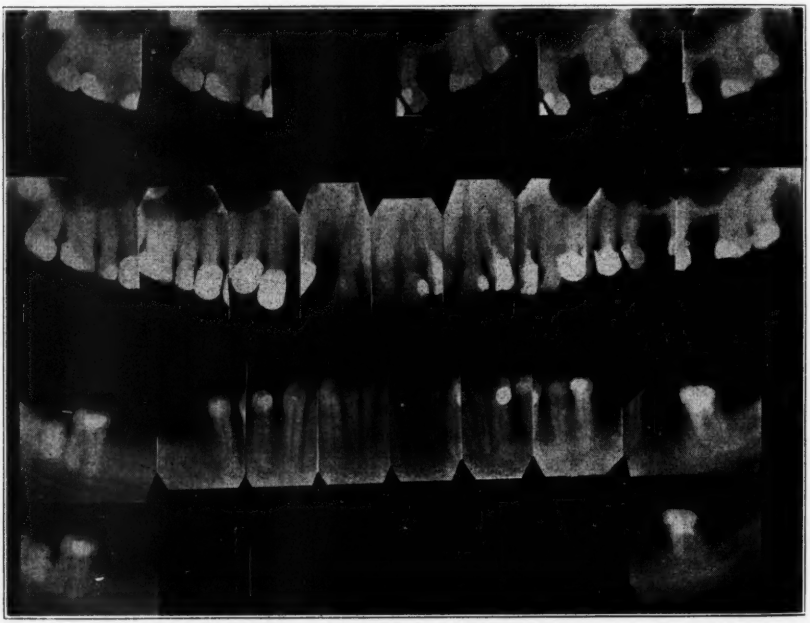

Fig. 10.—Hypercalcified bone. A full upper and partial lower denture are still in service. (Compare Figure 17.)

STUDY CASTS AS ADJUNCTS TO THE STUDY OF ATROPHIC CHANGES

To quote Key[2]:

> In a consideration of the causes of bone atrophy, it is necessary to emphasize the fact that bone, while it may be almost stone-like in hardness, is a living tissue, capable of undergoing changes in form and structure in response to either local or general influences. This is true not only of growing bone, but of adult bone as well, because, in the adult, the bone is constantly in a process of resorption and replacement, and the maintenance of the normal bone structure is dependent on a delicate equilibrium between these two processes. . . .
>
> Bone atrophy may be general, in that it affects the entire skeleton; or local, in that it affects only one bone or the bones in a certain portion of the body. As distinguished from atrophy, the term "bone absorption" should be applied to those changes which affect not the whole bone, but only certain regions, and results in the creation of gross defects in bone.

Study casts[4] used in conjunction with the roentgenograms vividly portray the effects of atrophic and hypertrophic changes in hypercalcemic and hypocalcemic bone. Their value as diagnostic aids to the prosthodontist has remained unstressed. This is all the more remarkable because they portray the physical appearance of both

servation that atrophy can be viewed with understanding if studied with the cast and roentgenogram as a composite picture.

Atrophic changes in the alveolar process are constant and are revealed in several different ways to the prosthodontist.

The first and most insidious of these

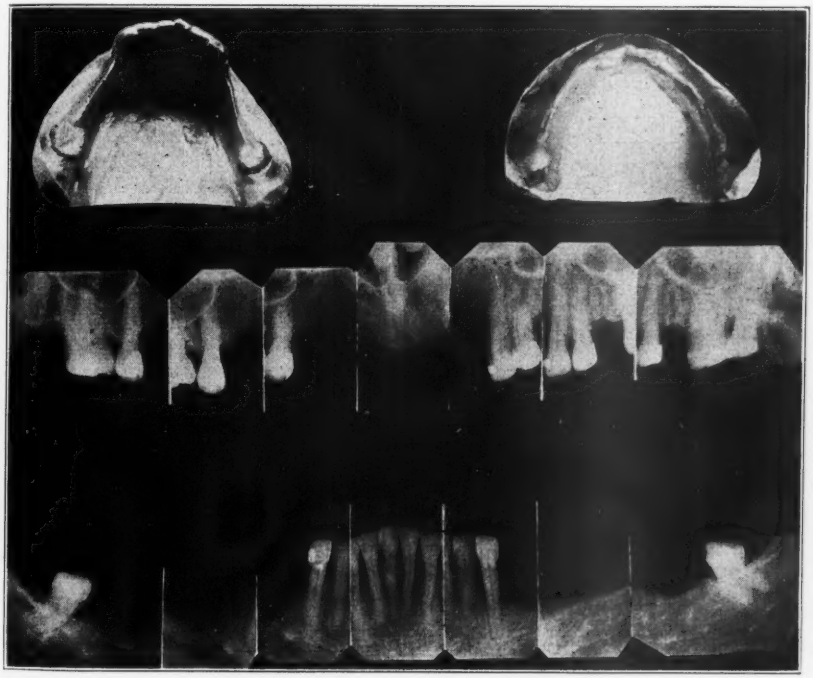

Fig. 11.—Hypercalcified bone in thyroidectomized patient.

the maxillary and mandibular processes as a result of atrophic and hypertrophic changes, which affect the stability of artificial dentures. It has been my ob-

is the need for rebasing of newly made artificial dentures. This is due to the instability of the transitory bases upon which artificial dentures rest, whether they be of the normal, hypocalcemic or hypercalcemic types of bone; all of which are subject to atrophic changes that differ only in degree. The change

4. McKevitt, F. H.: Atrophical Changes Occurring in Alveolar Process and Their Effect on Artificial Dentures, Proc. Pac. Coast D. Conf., 1929, p. 404.

which takes place in hypercalcemic bone can be regarded as a negligible factor in rebasing; particularly when the ridges have been surgically prepared and the prosthodontic steps have been orderly and efficient. Indifferent surgical procedures convert this bone, which is the most favorable for dentures, into the most unfavorable. Atrophic changes do not proceed rapidly and the alveolar process is slowly formed into a thin, high, sharp ridge, which causes pain and denture instability from pressure. These cases must be operated on again and dentures remade to assure stability and denture comfort. In hypocalcemic bone, the changes are the most rapid and necessitate early rebasing and the remaking of dentures. It has been found that, in this bone type, when the ridges have been surgically prepared for the reception of artificial dentures and allowed to drain and heal for six weeks, permanent dentures will serve without rebasing or renewal for a period of three years. These atrophic changes are little understood by the profession, who seem to attribute the need for rebasing to a technical shortcoming of their own.

A second form of atrophic change that is revealed clinically and by the study cast is a condition necessitating the crossbite arrangement of artificial teeth.

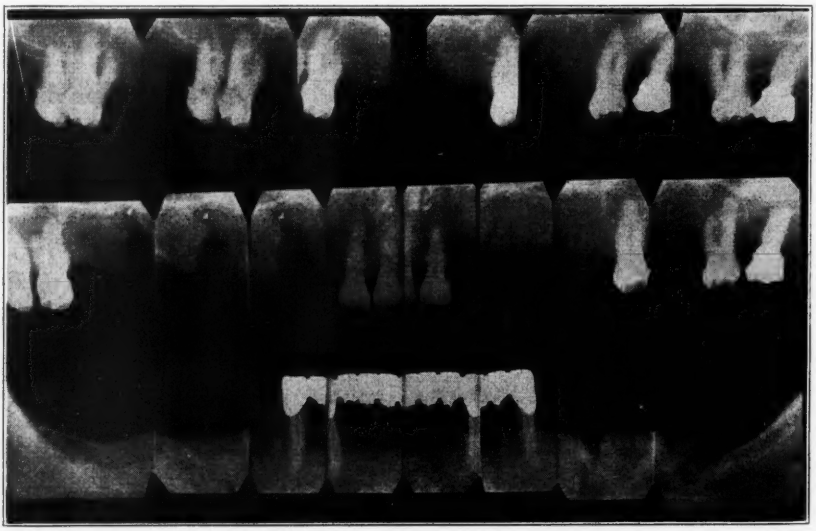

Fig. 12.—Hypocalcified bone, offering no resistance to exodontic procedures. The serrated ridge, formative stage, is shown.

To quote Gysi [5]: "When maxillary teeth are removed, the tendency is for the arch of the maxilla to narrow; and when teeth are removed from the mandible, the tendency is for the mandibular arch to widen." It has been observed that this tendency is more pronounced in the hypocalcemic

5. Gysi, A.: Special Teeth for Crossbite Cases, D. Digest, 34:100, (Jan.) 1928.

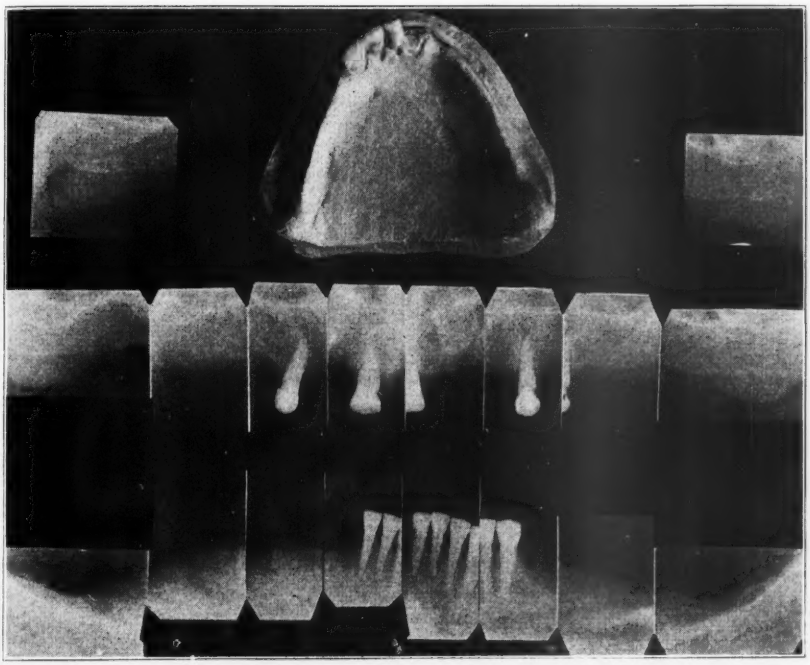

Fig. 13.—Hypercalcified bone, showing thin, high mandibular ridge.

Fig. 14.—Edentulous jaws, showing hypocalcemic bone in patient, aged 50.

bone type. To give artificial teeth a crossbite arrangement in such cases is one means of conserving this bone and of combating atrophic changes. This lies within the field of prosthodontia. A normal bite arrangement of the artificial teeth invites failure. The tendency is to break down the ridge, inhibit tongue movements, and produce cheek biting and denture instability.

A third and interesting result of atrophic changes is revealed by the gothic arch tracing. The asymmetrical loss of natural teeth and of the process due to atrophy has a tendency to create paths for the mandibular movements that differ from the paths used when all the teeth were present. These paths, acquired through a period of years, become the habitual channels for mandibular movement and the muscular habits thereby become fixed.

The roentgenographic index to bone types offered here may explain the cause and throw light on these three phases of prosthodontia. While no panacea exists at the present time to assure lasting qualities in bone foundations that lack durability as an inherent property, modern exodontia coupled

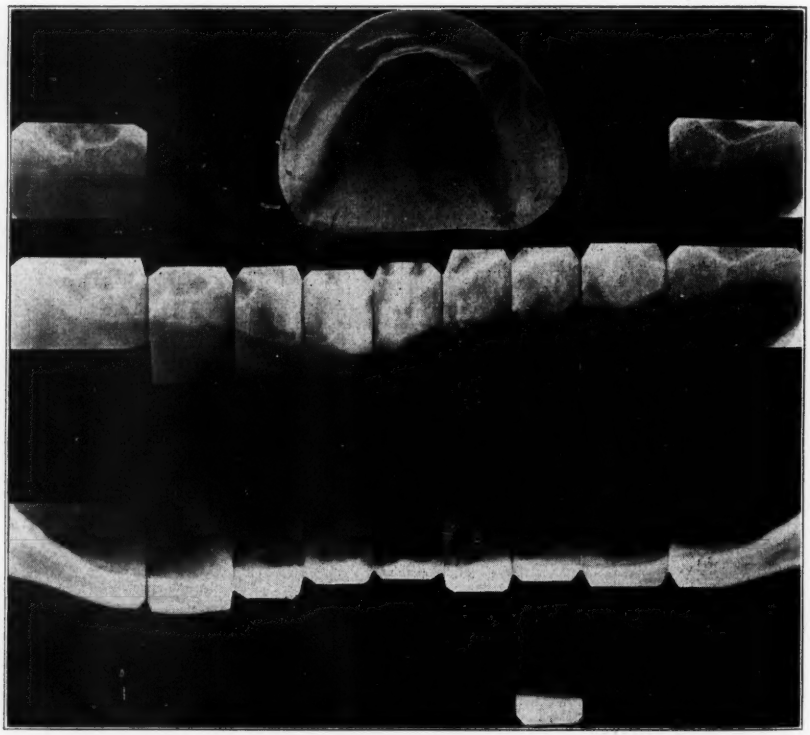

Fig. 15.—Senile atrophy in hypercalcified bone.

with good prosthetic practice will serve adequately and elicit a grateful response from patients, particularly when they are apprised of conditions as they are revealed by roentgenograms and casts. This ofttimes opens an avenue for medical cooperation.

To quote Marshall[6]:

> It would seem that a useful method of applying the present knowledge of dietary research would be for the dentists to secure more cordial cooperation with the patient and the physician. Unfortunately, however, there are too many instances wherein this cooperation either is not sought by the dentist or is refused by either the patient or the physician. The latter situation deserves a free and open discussion in the hope that a solution of the problem may be reached. Until this point is attained, the dentist is thrown, so to speak, on his own resources and perforce must designate, at least in a general way, those changes in the diet which a study of the case seems to indicate. Recommendations on choice of food are frequently necessary and may be made by the dentist without assuming any responsibility. Any further instructions should be left to the medically trained man.
>
> Dietary prescription is a different matter. It is based on a careful study by the physician of many data, gathered both by laboratory and by clinical methods, including basal metabolism and calcium metabolism tests. The interpretation of these data and their application is the duty of the physician rather than of the dentist. But the clinical application of these facts becomes the joint duty of dentist and physician.

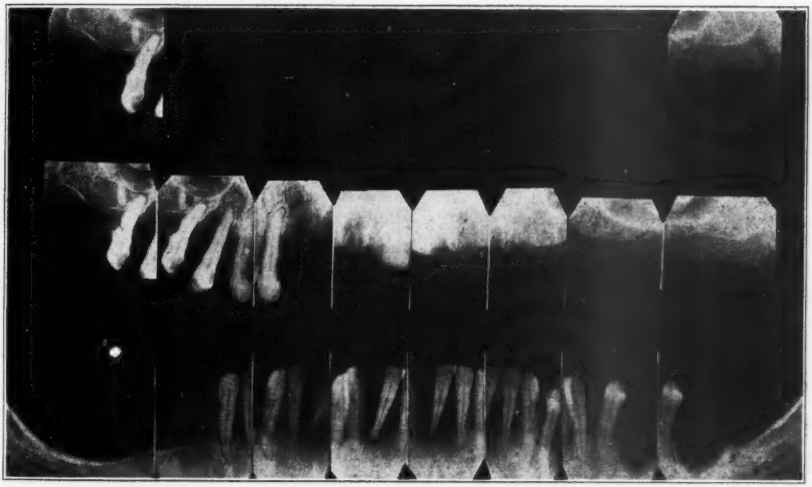

Fig. 16.—Hypocalcified bone. The decalcified remnant of the process shows in the roentgenogram as a gray shadow extending from tuberosity to tuberosity in the maxilla.

The accompanying illustrations will permit you to visualize roentgenographically some of the end-results of a disturbed calcium and phosphorus metabolism and the changes that result in bone owing to the withdrawal and deposition of calcium. This study has extended over a period of ten years in a consistent endeavor to account for prosthodontic shortcomings. My coworker, H. S. Spinney, of Santa Bar-

6. Marshall, J. A.: Will the Physician Prescribe the Diet? J.A.M.A., 97:1072 (Oct. 10) 1931.

bara, Calif., independently pursuing a similar study relative to bone changes in periodontal cases, concurs with these findings.

Figure 1 illustrates Reese's statement: "A well balanced body with harmonious functions of the endocrines, a dietary containing sufficient vitamins, beginning in uterine life, and modern dental hygiene are essential to develop and maintain healthy teeth."

of the blood serum and of the bones. Other factors operate to help in this same balancing mechanism."

Figure 3 shows hypocalcemic bone in a 15-year-old child. Before and during the time traction was applied by the orthodontist in this case, the bone was hypocalcified. In this bone type, the tooth structure is of the same relative density as the surrounding bone. That pressure from traction eroded the tender

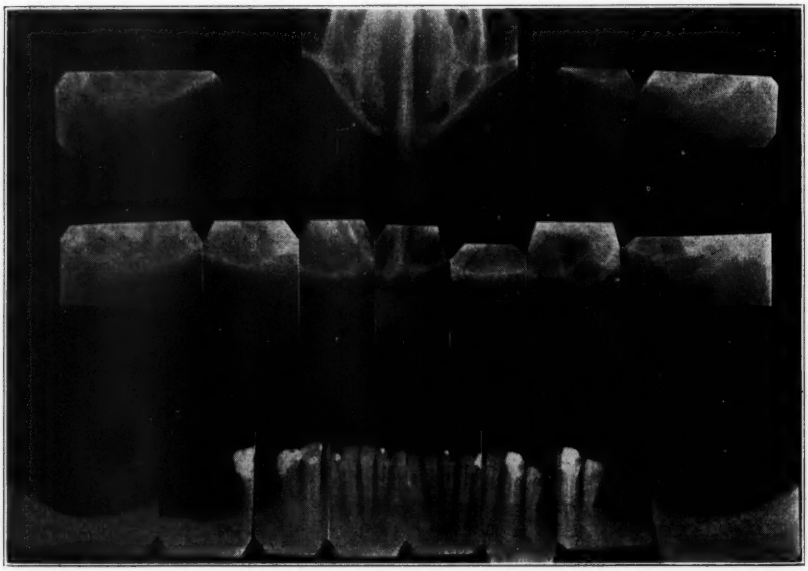

Fig. 17.—Hypocalcified bone; an osteitis fibrosa similar to that shown in Figure 16. Too long retention of the mandibular incisors has broken down the maxillary process and part of the maxillary bone. (Compare Figure 10.)

Figure 2 shows normal alveolar bone. The patient's age was 16. The picture is intended to show the roentgenographic appearance of normal alveolar bone resulting from a harmonious balance between the endocrines and a proper diet. Reynolds says, "The parathyroids function normally to help in the maintenance of calcium balance

root is questionable as no roentgenograms were taken before the appliance was placed. A diet rich in calcium coupled with body irradiation may be indicated in these cases before orthodontic treatment is started. The absorption of root apices is not due in every instance to orthodontic procedures. Similar conditions result from the presence

of high fillings and malocclusion when no orthodontic appliance is used. Opening bites arbitrarily with improperly carved hard gold inlays or crowns in reconstruction cases has a tendency to produce absorption of root apices, particularly in hypocalcemic and normal bone cases. In hypocalcemic bone, intermittent pressure on high fillings or malocclusion teeth will produce eburnation or hypertrophy of bone and by hypercementosis.

Figure 4 shows hypocalcemic bone. The parents of this patient were both edentulous before their fiftieth year. The care of this mouth was scrupulous. To quote Reese[1]: "We are today interested in the influence of vitamins on the teeth. The clinical observations and theories of Black, McKay and Bliss . . . that faulty nutrition was the cause of caries has been confirmed by animal experimentation." Reynolds states: "Aub and Salter have recently demonstrated that calcium fails to be deposited in bone when the diet, though adequate in calcium, is deficient in Vitamin C. The subsequent addition of Vitamin C to such a diet allows calcium to be deposited rapidly."

Figure 5 shows a +3 hypocalcemic bone condition theoretically caused by hyperfunction of the parathyroids. The tendency of the alveolar process to leave the cervices of the teeth and the relation of the superior border to the antrum membrane in the maxilla and of mandibular alveolar crest to the bifurcation of the mandibular molars are evident.

Key would describe this as a generalized atrophy. Becks[7] would recognize it as horizontal atrophy. The profession terms it pyorrhea. Ultraviolet irradiation, glandular therapy and proper diet might fix calcium in the trabeculae in pyorrhea cases.

Figure 6 shows a nearly normal bone case, in a patient, aged 36, of Italian extraction, on the usual diet rich in calcium: corn, wine, oil, green vegetables, fruits, etc. A 100 per cent normal case is difficult to find. This illustration is to be compared with Figure 3 and the similarity of the trabeculae formations and the color tone of their contents is to be noted.

Figure 7 shows hypercalcemic bone condition caused theoretically by hypofunction of the parathyroids, in a patient aged 38. The trabeculae are closely knit and the teeth are comparatively free from caries. In this case, the bone was of such density that, to remove an impacted maxillary molar, it was found necessary to remove the second molar. Dry socket or osteitis usually occurs in this bone type because of its nonvascularity. Eburnation at the region of the distal root of the mandibular right first molar may be noted. (The spot on the tooth is a photographic artefact). It may be of interest to note that the mother of this patient had a goiter history. The tooth structure in this bone type is as relatively dense as the surrounding bone.

Figure 8 shows hypercalcemic bone in a patient, aged 28; a case of retention of calcium and phosphorus with hypercalcification. To quote Reynolds: "Greenwald demonstrated this retention after parathyroidectomy in dogs. According to many observers, there appears to be a close relation between hypoparathyroidism and abnormal calcification such as occurs in Paget's disease, juvenile sclerosis, renal sclerosis, otosclerosis, etc."

7. Becks, H.: Normal and Pathologic Pocket Formations, J.A.D.A., 16:2167 (Dec.) 1929.

Figure 9 shows hypercementosis in hypocalcemic bone. The development of hypercementosis in this bone type is widespread because of the nonresistance of the surrounding soft bone to pressure, the cementum being of the same relative density as the tooth and bone structure. The maxillary and mandibular edentulous areas (lower left) will indicate the vertical loss of alveolar bone, fifteen months after removal of the molars. The rapid atrophic change in this bone type accounts for the failure of full and partial dentures. This patient has a history of hypertrophic arthritis.

Figure 10 shows hypercalcemic bone. The maxillary teeth were removed, Dec. 8, 1923, with the mandibular molars, and replaced with a full maxillary and partial mandibular denture, which are still in service. In a similar case of hypocalcemic bone, all the mandibular teeth would have been extracted to insure uniform settling of the denture and the conservation of the maxillary ridge. (Figure 17.) In this type of bone, partial dentures are indicated and seem to serve adequately for long periods, if well made. The tendency for this bone to resist atrophic changes makes it an ideal base for full and partial restorations, particularly if the ridges have been surgically prepared.

Figure 11 shows hypercalcemic bone in a patient who had had a thyroidectomy. Hypercalcemic bone is highly resistant to atrophic changes. The cast on the upper left is of the mandible before the removal of the teeth; on the right, after their removal. The bone was unusually dense and brittle and presented a thin knifelike ridge. The patient could not tolerate a partial mandibular denture. The eburnated or hypertrophied bone in the edentulous bicuspid area and throughout the mandible indicates the presence of this bone type. It is probable that the presence of unusually hard and brittle bone in this case was due to removal of too much of the parathyroids with the thyroid; but this is, of course, only an empiric observation.

Figure 12 shows hypocalcemic bone. This bone offers no resistance to exodontic procedures. Rapid extraction under gas is evidenced by the gouged out portion of the maxillary alveolar process in the roentgenogram. Partial maxillary and mandibular dentures settled immediately because of atrophic changes. This diagnosis and prognosis was made from the roentgenogram and the patient advised accordingly. Key[2] says: ". . . civilized man exists on a rather close margin of safety as regards calcium. . . . Aub and his co-workers have recently shown that this calcium is withdrawn from the trabeculae in the cancellous bone, and that if an animal is maintained for a long time on a diet which is so low in calcium that the calcium balance is negative, there is a gradual disappearance of the trabeculae in the cancellous bone. From these observations, they have been led to the conclusion that the trabeculae represent a calcium reserve, the object of which is the maintenance of the normal blood calcium."

Figure 13 shows hypercalcemic bone. The high, thin mandibular ridge in the roentgenogram is shown also in the cast of the same case. Full or partial dentures cannot be worn with stability unless the ridge is surgically prepared.

Figure 14, from an edentulous case, shows the roentgenographic appearance of hypocalcemic bone in a patient, aged 50. The relation of the maxillary crest

to the antrums, also the vertical dimension of the mandible and wide inferior dental canal, are to be noted. Such cases require rebasing early and renewal every third year to keep pace with atrophic changes. It would seem that a prescribed dietary regimen of forced calcium feeding and body irradiation would be indicated here as was suggested in Figure 3 for the purpose of bone "fixation," but, with a succession of denture failures in some instances, patients become discouraged and refractory. In these cases, the centric relation of the mandible secured by the gothic arch tracing is soon lost. One of the uses of the gothic arch is to determine the centric relation of the mandible to the maxilla. In this bone type, the horizontal and vertical position of this centric relation cannot be maintained because of atrophic changes.

Figure 15 shows a case of senile atrophy in hypercalcified bone. That punched out appearance of the remnant of the mandibular alveolar process is shown in the roentgenogram, and the vertical dimension of the body of the mandible from the inferior border to the superior border. The cast is of the same mandible. This patient was 75, vigorous and aggressive. She had worn the same dentures for over thirty years. The presence of hypercalcemic bone will probably account for this fact and for similar statements by other denture wearers.

Figure 16 shows hypocalcemic bone. Theoretically in cases of long continued hyperactivity of the parathyroids, calcium is withdrawn from the skeleton to supply bodily needs. This results in osteodistrophia fibrosa. The decalcified remnant of the process shows in the roentgenogram as a gray shadow extending from tuberosity to tuberosity in the maxilla. Unless excised, this tissue becomes an unfavorable base for a maxillary denture because of its resiliency. The remaining mandibular teeth are about to the exfoliated because of the decalcifying process.

Figure 17 shows a hypocalcemic bone condition, possibly due to long continued hyperfunction of the parathyroids, producing an osteodistrophia fibrosa similar to that shown in Figure 16. In these cases, the too long retention of the mandibular incisors breaks down the maxillary process and part of the maxillary bone. A knowledge of these bone types permits nice discrimination in diagnosis. In this type, the remaining mandibular incisors should be removed to conserve bone and permit of the uniform settling of dentures. In Figure 10, the conditions are the exact opposite. The mandibular incisors can be retained with impunity and partial replacement can be employed successfully.

450 Sutter Street.

MODIFIED FLAP OPERATION IN SURGICAL TREATMENT OF PERIODONTOCLASIA*

By OLIN KIRKLAND, D.D.S., Montgomery, Ala.

PERIODONTOCLASIA is found in some stage of its development in almost every adult mouth, which perhaps classifies it as one of the most common diseases known to exist among men. A low-grade infection results in a progressive inflammation of the periodontal membrance and alveolar bone, and has associated with it more or less pus and bacteria.

An oral disease that is known, from the records of early history, to have existed since the beginning of civilization, that throughout the ages has been a cause of man's discomfort and that shares equally with caries in the responsibility for the loss of teeth is a disease that is necessarily of paramount interest to the dental profession.

Owing to the infectious nature of this disease, and the danger of bacterial absorption from its location in tissues so abundantly supplied with blood vessels, such affected areas have come to be recognized by pathologists as foci of infection of vast importance, as the condition is credited with responsibility for a variety of painful and disabling diseases.

Since man first realized that this disease was the cause of pain and discomfort, there has been a search for ways and means to effect its cure. Comparatively little progress seems to have been made until recent years.

The earliest efforts to treat the disease employed therapeutic agencies, but at best these have proved to be only palliative. What is generally regarded as a more or less radical surgical procedure has proved by far the most dependable method of treatment, and there is little doubt concerning the possibility of eradicating the disease by following this course. Owing to its importance as a dental problem, every dentist should know more about the disease, and the most practical methods of its prevention and cure.

The successful management of disease is like all other intricate problems in life —dependent on an intimate knowledge of all its important factors. Therefore, the successful treatment of periodontoclasia must be founded upon knowledge concerning the disease and its etiology and diagnosis, which naturally leads to the most rational conclusions regarding its treatment.

There are so many theories concerning the source of periodontal disease that time and space forbid entering into a discussion of the subject from that viewpoint. All investigators are agreed on one point, and that is that bacterial growth, with the products of bacterial fermentation within the pocket, is the most important etiologic factor in the disease, and must be eradicated in all cases, in order that it may be treated successfully.

The purpose of this paper is to call attention to a simple, easy and rational

*Read before the South Carolina Dental Association, Greenville, S. C., May 23, 1932.

method of removing the cause by following a surgical technic that has been used successfully for many years.

The periodontal pus pocket, when surgically treated, should respond most readily, owing to the abundant blood supply found in the structures surrounding the teeth, which provides ample nutrition and assures elimination of the bacteria that may be forced into the tissues through operative procedure.

When the lesion has reached the advanced stage of development, surgical treatment is always indicated, and this is the only sure method of its eradication. The flap operation which will be discussed in this paper suggested itself to me as a simplified modification of the Widman technic, which has been repeatedly described in dental literature by Zentler, Nodine, Berger and others.

In a practice limited to the surgical treatment of periodontal disease, I have, during many years, followed several different methods, but I have always found the modified flap operation the most satisfactory procedure where single-rooted teeth are involved. In this technic, there is but little more trauma than usually results in following the conservative subgingival curettage method, with infinitely greater prospects of success, and with but slight if any change in the appearance of the gum line.

While the modified flap operation is ideal in its place, and may be used indiscriminately in all cases involving the single-rooted teeth, it is not always indicated in the treatment of multirooted teeth, as it does not provide for sufficient drainage where interradicular inflammation has caused resorption of the bone structure within the bifurcation.

In such cases, it is preferable to follow a gingivectomy technic which provides for the removal of all gum tissue overlying the pus pocket, assuring better drainage. In the treatment of cases in the molar areas that involve only the interproximal tissues, and in which there has been no pathologic absorption of the interradicular bone tissue, the modified flap operation may be used effectively.

In the treatment of areas in which a flap operation is indicated, owing to the slight trauma to the soft tissues, this method has advantages, as compared to other surgical procedures: easy access to and visibility in the field of operation, preservation of the gingivae and esthetic value in preserving the original appearance of the gum line, and the conservation of healthy bone tissue, which may be used for the purpose of bone building within the pocket.

In all other surgical methods described in dental literature, the healthy alveolar bone is trimmed down to a point near the depth of pocket destruction. This is not necessary in the modified flap technic and should not be done, as a small bit of healthy bone, when preserved and covered with a clean healthy flap, may be made useful as a matrix to which it is possible for new bone cells to find attachment, and around which new bone tissue may rebuild in the process of repair. Any effort to encourage nature in the replacement of new bone tissue in the pocket area, through the process of regeneration, is defeated as a consequence of the destruction of healthy bone surrounding the pocket.

EXAMINATION

In the treatment of disease, the first and one of the most important steps is examination, which leads to conclusions upon which diagnosis may be determined. The procedure to be outlined in the plan of treatment must be directed according to the findings in each individual case.

Consequently, the success or failure in the management of disease is to a great extent dependent on an accurate examination. This could not be regarded as satisfactory without a roentgenographic survey of the teeth and their supporting structures. This should be required in each case, in order that suspected teeth and rarefied areas may be carefully studied.

The color and tone of the gingivae and their relationship to the teeth at the cervical borders should be noted, and, with mouth mirror, diagnostic light and probe, every part of the gingival crevice around each tooth should be examined for pockets.

When we observe symptoms that cause us to suspect that the general health is involved, it becomes our duty to advise a consultation with the family physician, as he knows much better than we do how to handle general pathologic conditions.

TRAUMATIC OCCLUSION

Physiologic function must be restored to those teeth involved in traumatic stress, as abnormal occlusal force causes undue pressure on the pericemental tissues, thus involving the blood supply, and, as a consequence, is one of the fundamental causes of disease. Teeth involved in pathologic functional stress are always loose, the degree of movement depending on the duration of force and the direction of overstress.

When restored to physiologic function, loose teeth under traumatic stress will, in a short time, and without any other treatment, become less mobile in their sockets. Traumatic occlusion should be relieved prior to treatment, because mobility of the tooth may interfere with healing and reattachment of the tissues to the root surface.

Abnormal movement of teeth in function is contrary to the laws of nature, and owing to its disturbance of pericemental circulation, may prevent proliferation of new cells in the process of tissue building. Without first relieving traumatic stress, we could not anticipate any better results in the treatment of periodontoclasia than the physician could expect in the treatment of bone fracture without properly reducing the broken parts.

TREATMENT

Superficial scaling of the teeth should be the first consideration in the treatment, followed by prophylaxis and stimulation of the gingivae until congestion has been relieved and the tissues assume a healthy pink appearance.

The same careful aseptic precautions followed in other surgical procedures are essential in the surgical treatment of periodontal disease. Careful anesthesia is most important in periodontal surgery, and either infiltration or the block method, using procain, has been found satisfactory.

When the field of operation is thoroughly anesthetized and disinfected, and the hands, sponges, dressings and instruments are aseptically prepared for surgical procedure, a thin narrow-bladed knife is passed vertically into the gingival crevice, following the pocket to its full depth. An incision is made in either a mesial or a distal direction through the interdental gingiva, separating it in two parts, so that one flap may be retracted labially and the other lingually. The flaps are retracted with a periosteotome, and carefully pushed back sufficiently to permit the insertion of a fork, with which the flap may be drawn back to provide an opening wide enough to insure free movement of instruments and an unobstructed view of the field of operation. The diseased granulation tissue is loosened with spoon-shaped curettes and is trimmed out with small shears, after

which the wound is washed and sponged. The entire pocket is now open to view, and the exposed roots and diseased bone can be thoroughly and expeditiously curetted.

In addition to the use of sponges, an aspirator will be found most helpful in keeping the field of operation dry and free from the annoyance of blood and saliva.

To avoid excessive trauma, the gingivae should not be retracted more than 1 or 2 mm. beyond the depth of the pockets.

For final inspection, the wound should be washed with physiologic sodium chlorid solution, or surgical solution of chlorinated soda and thoroughly dried, and if there are any deposits left on the root surfaces, they are exposed to view, and may be removed without difficulty.

When the etiologic factors have been completely eliminated, the wounds are closed by passing sutures labiolingually through the interdental flaps. This is accomplished with small curved needles and No. 0000 fine dental sutures. The sutures should be the only visible postoperative evidence if the technic has been correctly observed.

To stimulate the tissues in the area of operation it is good practice to use cotton packs dipped in hot sterile water. The packs should be folded in a clean towel and some of the excess water squeezed out. After cooling sufficiently to be tolerated by the soft tissue, to avoid blistering, I place packs on each side of the teeth and covering the operated area, holding them in position till they lose their heat. These applications should be repeated several times.

After thorough drying of the teeth and gums, a sterile wax dressing compound of 3 parts beeswax to 1 part sticky wax is fused in a suitable container, such as a procain dissolver, and painted over the field of operation with a camel's-hair brush.

The sutures should not remain longer than five or six days, during which time the patient is instructed to wash the mouth frequently with physiologic sodium chlorid solution, and to resume brushing the teeth and gums with gentle force. This is to be gradually increased as the gums become firm, resistant and healthy.

The Charters' method of brushing is preferred because of its stimulating effect on the gingivae. The brushing should be supplemented by the use of tape in the interdental spaces.

In order that we may feel reassured that proper healing of the wounds is in progress and that the teeth and gums are receiving attention as directed, it is advisable to have the patient return in about four weeks for inspection, at which time the teeth should be thoroughly cleaned, polished and rechecked for occlusal stress. After this, semiannual visits are required for prophylaxis and inspection, the occlusal relationship being noted at such visits.

Cooperation of the patient is essential to success in following this technic, as in all other methods of treatment, and without it there is but little hope of permanent results.

GENERAL PRACTITIONER AS A RESEARCH WORKER: WITH A CONSIDERATION OF THE RÔLE AND RESPONSIBILITY OF THE UNDERGRADUATE SCHOOL IN THIS CONNECTION*

By JAMES L. ZEMSKY, D.D.S., New York City

IT has been definitely established that clinical research as well as laboratory research is essential for the most satisfactory progress of the healing profession. Another fact that is also pretty well established and which should be mentioned in this connection is that a practitioner, in his great zeal to relieve pain and treat the suffering patients, almost invariably not only sacrifices a careful working up of the cases, but even leaves unrecorded his observation. This is a truly deplorable situation, for since incomplete records are absolutely worthless from the scientific point of view, the gathering of very important clinical data becomes impossible. Therefore, the attitude of the clinician devoting his entire attention to the patient by giving his best and most immediate care to the sick is open to criticism, for, paradoxical as it may seem, he is thereby completely ignoring his patient as well as his obligations to the whole profession.

This criticism seems justifiable for the reason that, under such circumstances, the advancement of the healing profession would be impossible; a situation which must be regarded as quite alarming, particularly when it is realized that the healing profession is no longer contented with merely treating disease, but is greatly concerned with its alleviation and prevention. To this end, more and more research is being conducted. Foundations for most extensive scientific investigation come into being through the generosity of public spirited persons who realize the importance of it. Full-time investigators are engaged to carry on the work; scientists in the many different branches are continually experimenting in their laboratories, which are most elaborately equipped for the purposes intended. These institutions offer opportunities not only for every conceivable type of research in the laboratory, but even for clinical research, as for example, the Rockefeller Institute for Medical Research.

This brings us to a consideration of the most important phase of scientific investigation in which the healing profession is vitally interested, namely, clinical research. In this connection, rather discouraging observations can be made in view of the fact that investigations of this type so far accomplished are, relatively speaking, insignificant when compared with laboratory research. To cite a few illustrations, probably the best example

*From the Department of Oral Surgery, Midtown Hospital.

*Read at the tenth annual meeting of the International Association for Dental Research, Columbus, Ohio, March, 1932.

concerns the question of the relationship of oral foci of infection to systemic disease. At no time has this theory been more widely discussed. It seems that anyone who has been observing the attitude of the general practitioner would be led to believe that, more and more, he is joining the ranks of the conservative group. Waldron,[1] for instance, points out that "when one discusses the relationship of diseases of the mouth and systemic disease with experienced pathologists, one is immediately beset with the thought, "Is there any important relationship?" He further calls attention to the fact that "a survey of the textbooks on pathology shows that the authorities on this subject, which is so fundamental to the science and art of medicine, have been very slow to accept the presence of dental focal infection." To illustrate this statement, he points out that textbooks on pathology give this subject but little space, and he calls attention to a recent textbook in which about sixty lines are devoted to the general discussion of focal infection of teeth, tonsils, sinuses, gallbladder, appendix, etc. Reference to the teeth as foci includes about six lines:

> The importance of the teeth as sites of focal infection has been overemphasized by many physicians. Latent dental infections, root granulomas are seldom responsible for metastatic lesions. Hypertension is not due to focal infection and the practice of extracting suspected teeth in this condition is to be condemned. Obscure anemias are usually not caused by focal infection."[2]

All of which means that intensive laboratory study did not succeed in proving the validity of the theory of focal infection and the clinic thus far has also failed to clarify the situation, and this despite the fact that a number of most capable investigators and observers have studied this subject intensely for a number of years. The cause of this failure becomes quite apparent after some thought, the answer being that it is impossible for laboratory workers, even if they are aided by a few clinical observers, to determine the validity of this theory. This cannot be done until a large number of clinical cases shall have been studied, and it is obvious that a few clinical workers are not in a position to study the required number of patients. Such a serious problem can be solved only when a tremendously large number of investigators shall be engaged in its study. For them, it should be a simple task, the only requisite being an examination of hundreds of thousands of patients suffering from any of the manifested disturbances, with evidence as to whether there exists the relationship claimed.

Until that time, the theory of focal infection will remain neither universally accepted nor rejected; a situation resulting which is, to say the least, chaotic; for what else can a condition in a profession be called, when the opinion and advice offered by one practitioner is not infrequently diametrically opposed to that of another and occasionally even ridiculed by other members of the profession. Such a state of affairs would obviously be impossible if a sufficiently large number of clinical cases were studied, affording indisputable proof either in support or in refutation of the theory. But patients in such tremendously large numbers as are necessary for such purposes are not available in institutions regardless of how well these may be equipped and what the facilities for such work may be. Now, we come to

1. Waldron, C. W.: Basic Medical Courses, D. Survey, 7:63 (May) 1931.

2. Bell, E. T.: Pathology, Philadelphia: Lea and Febiger, 1930.

the crux of the situation: we realize, on the one hand, that clinical research conducted on a very large scale is absolutely essential for the progress and efficient practice of the healing profession and, on the other, that the clinical research as it is carried on at the present time, both because of the quantity of material studied and the number of the practitioners engaged in the investigation, is insignificant and consequently absolutely inadequate. Here, then, is the justification for calling the situation deplorable.

IMPORTANCE OF THE GENERAL PRACTITIONER IN SCIENTIFIC INVESTIGATION

Having established that the solution of this particular problem, as well as many others, would be possible only when a large number of clinical investigators became engaged in such a study, the next question is how to obtain so many workers and the needed material. The answer to it is that they must be recruited from the rank and file of the profession. The general practitioner must be drafted and a clinical research worker made of him, for the reason that he is in a position to study the patient for a long period of time, a thing impossible either for a laboratory worker or for a specialist. He can observe the changes which may occur in a patient from the early days of childhood to adolescence, and, in some instances, even to old age. As he comes in contact with many members of the same or related families, he has an opportunity to study his patients from the point of view of heredity and familial influences and environment, and from other angles. So much, then, for the place of the general practitioner in any investigation to determine the necessity or value of different operative procedures in coping with the various conditions. There are other phases of the problem which the practitioner engaged in clinical research can solve.

Let us now evaluate the general practitioner as an investigator.

SKEPTICISM OF THE RESEARCH WORKER REGARDING INVESTIGATIONS BY THE GENERAL PRACTITIONER

It has been often observed that the attitude of the scientific investigator toward the general practitioner as a research worker is that of a skeptic. While there may be some justification for this, there are others who maintain that the research worker is only partially justified in his attitude. Why? Because the problem is largely one of educating and training the general practitioner to become interested, and the situation can be readily modified in the near future. That this idea is not original is apparent. In a study of the literature on the subject, Pollia [3] states that "a well-trained clinician is just as capable of carrying on a research problem as a full-time student, provided he or she confines the investigation to clinical problems." Another writer sharing this view is Harvey Cushing,[4] who holds that "there is no inherent reason why the qualities of investigator, teacher and practitioner should not go hand in hand, be represented in a single individual and be none the worse for the mixture." That this view is not new is evident from a study of much older works, among which that of Claude Bernard [5] stands out.

3. Pollia, J. A.: Newer Concept of Focal Infection, J. D. Res., 11:83 (Feb.) 1931.

4. Young, F. B.: Clin. Med. & Surg., December, 1931, p. 886.

5. Bernard, Claude: Experimental Medicine, New York, The Macmillan Co., 1927.

This brilliant investigator says:

> I tell those whose career guides them toward practice never to forget that if theory is meant to enlighten practice, practice in turn should be of use to science. Physicians thoroughly imbued with these ideas will always keep their interest in the progress of science, at the same time that they do their duty as practitioners. In noting accurately and acutely the interesting cases that present themselves, they will understand how fully science may profit by them. Experimental scientific medicine will thus become the achievement of us all; and everyone of us, even if he be only a simple country doctor, will make his own useful contribution.

The question that would naturally suggest itself now is: Why is it that although so many have urged the practitioner to contribute his share to science, practically nothing has been done. The answer is that there is no definite plan of procedure.

AUTHOR'S PLAN OF PROCEDURE

In an attempt to work out a practical plan for clinical research which could be carried out by the general practitioner, an analysis of his characteristics as a human being and as a professional man must be made. His general economic condition must also be taken into account and his patients as a class must necessarily be studied also.

Analyzing the practitioner as an individual, we must consider (1) his character and (2) his social standing. In considering him, as a professional man, we must take into account (1) his training, this to include (*a*) special studies, (*b*) general education and (*c*) research work done by him; (2) his associations, specifying (*a*) special or (*b*) general organizations in which he holds membership; (3) his ability, considering the type of (*a*) original research, (*b*) professional accomplishments and (*c*) organization work; and (4) his interest in the various special fields in which he is most proficient.

From a study conducted along the above-indicated lines, it will be learned that the practitioner is a hard working man whose characteristics as a rule will include some of the following: lack of initiative, pessimism, indifference; inertia, timidity, laxity, lack of confidence, lack of energy and procrastination. This is assumed to be true, for otherwise the man would occupy an exceptional position, be an outstanding figure, a leader in the profession. Then, it must not be forgotten that he is occupying a certain social position in his community, which must be maintained, and this requires that his income also be maintained, which consequently demands that the amount of his working hours be not reduced. Therefore, to ask a practitioner to become engaged in research work would be unfair, since this will necessarily take part of his time, thereby reducing the number of working hours and resulting in a lessened earning capacity. A plan can be so devised that such sacrifices will be unnecessary, and when the practitioner becomes cognizant of it, there will be no difficulty in enlisting him in the work of clinical research.

The next important thing to consider is his qualifications. It is a well-recognized fact that, as a rule, one does not care to work unless there is some impelling force. There must be some incentive, and, if a plan is to be workable, this must not be ignored. Further, it must be taken into account that the general practitioner has not received any training in the field of scientific investigation. He has studied a number of varied subjects, but research was not included, and unless one has been defin-

itely trained, no amount of special or general knowledge will prove of any help in his attempt to carry on scientific research. It naturally follows that if an attempt is made to put the practitioner to work to do scientific investigation, there should be some provision in the plan for him to receive the necessary training.

Professional association produces a marked effect on any practitioner; therefore, if a practitioner is to do any work in clinical observation, a constant contact with other clinical investigators is essential. A fact which must be borne in mind is that not every practitioner is capable of doing things as these are done by someone else, but that he is nevertheless able to do certain things in a creditable manner. This should not be lost sight of in connection with the working out of a scheme to have the practitioner do scientific investigation. Finally, it should be kept in mind that every practitioner may have a particular interest in certain phases of his practice.

In a word, in order to induce a practitioner to enter actively the field of scientific investigation, it is not enough to point out the importance of this and urge him to go ahead. To arouse his interest is one thing; to induce him to enter on such work is an entirely different matter. A few well-written articles may arouse his interest, but do no more. To prove this, no argument is necessary. The fact that there is little clinical research conducted by the practitioner should be sufficiently convincing. In my concept of clinical research, every practitioner would be engaged in it, but his work would not be carried on independently but rather collectively. The only part of such a research that is done individually is the gathering of data, which will be easily accomplished under the following plan.

AUTHOR'S PLAN OF PREPARING CLINICAL RESEARCH WORKERS

To overcome the natural handicap of the individual practitioner, to encourage, guide, help and instruct him in clinical research, we need an organization by which it will be possible to stimulate the practitioner to do his share. He will be shown that, in doing his part, he will not be forced to make any great sacrifice of time or energy and that all that would be demanded of him is accurate observation and careful recording of just a few cases, which, when multiplied by the number of men engaged and the years that they stay in practice, will give the necessary mass of evidence. As a compensation for his work, a formal recognition in some attractive form will have to be offered by the organization; this in addition to the realization that he is doing his part in upbuilding the profession and helping the public will prove both a satisfactory reward and an incentive. Incidentally, there may be some material gain made through the contact with new people. By forming groups of workers, every practitioner may select problems which are of greatest interest to him. Individual ability and capability will not play any important part and therefore every practitioner will be encouraged to participate and on an equal basis with the next person. I should like to repeat the words of Dr. McCall, who, in discussing my paper[6] at Memphis, said:

Because of the fact that research is usually carried out in a laboratory and that such

6. Zemsky, J. L.: Clinical Research by General Practitioner, J.A.D.A., 19:12, Jan., 1932.

work usually requires highly specialized training on the part of those who carry it on, the very word "research" has come to be endowed with mystery, and it has come to be an accepted tenet that but few people are capable of doing research work. Neither of these things is necessarily true, and it therefore is possible to state unequivocally, that a large percentage of the general practitioners of dentistry are capable of doing some type of research work. Particularly is this true of the clinical research that Dr. Zemsky proposes. What is needed for this kind of research is nothing more or less than the ability to make accurate, complete and unbiased observations of the clinical facts presented in each case under study and the patience to record the findings of each case in a systematic and homologous manner. Let us next inquire as to whether records so made are to be considered as constituting reliable scientific evidence on the subject of the research; for unless the results can be accepted as reliable, the labor of getting the information together will have been in vain. What are the conditions which bear on the question of reliability? First, we have the very serious question of the variability of the persons to be studied. A thousand and one factors enter into the makeup of the individual and his reactions to his environment. He may be affected by one or more of a wide variety of diseases, and even a single disease may affect different persons in different ways. This wide variability of the effects of various combinations of disease conditions may seem at first glance to end at once any consideration of the possibility of doing reliable clinical research work in any field whatever. Such is not the case. For instance, the variability of persons as regards length of life does not preclude the development of accurate life expectancy tables such as are used by life insurance companies for computing their premium rates. These tables are accurate for the reason that they are based on a compilation of a large number of cases; and when variables are spread over a sufficiently large number of cases, the average behavior can be estimated with considerable accuracy. This is the answer to the basic difficulty in Dr. Zemsky's proposal. Granted that the collection of data on a sufficient number of cases will make it possible to draw reliable conclusions, we are then confronted with another difficulty, the possible variation in the observations of different dentists. Will two different dentists see the same thing in the same way and draw the same conclusions from it? This question is perhaps harder to answer. But the difficulty is not insurmountable. A reasonable uniformity can be attained by setting up comprehensive objective standards which may serve as the criteria for the observations.

This, then, is my plan, which I feel confident will result in engaging a large number of practitioners in clinical research. In the foregoing discussion, I left one thing out, namely, the training of the practitioner. This I shall consider now.

RÔLE AND RESPONSIBILITY OF THE DENTAL SCHOOLS IN TRAINING THE PRACTITIONER FOR CLINICAL RESEARCH

The responsibility of a dental school is to prepare its students for the practice of dentistry. This, as already pointed out, would be impossible without their participation in clinical research and, in this connection, a school must train its students in the fundamentals of clinical investigation. It is singularly fortunate that, in this particular field, many years of preparation is unnecessary. An efficient clinical research worker may be produced without the years of training and experience usually required to become proficient in other branches of scientific investigation. The only requisites for participation of the general practitioner in scientific research are acquaintance with the principles of such work, and realization of its importance.

These fundamentals should be taught in the dental school as part of the curriculum. The dental student should be acquainted with the fact that there are many unsettled problems in the practice of the profession for which he is being

trained, and that these problems could not be solved without the general practitioner, who must therefore take an active part in it. It should be pointed out that the patients whom the student may see on his entrance into practice are the very ones needed to complete some extensive study and that, therefore, these cases must not be passed unnoticed. The attention of the future practitioner should be directed to the fact that this clinical research, important as it is, will not require any great sacrifice of time or energy and that all that it will demand of him is accurate observation and a careful recording of findings. He should also be impressed with the fact that although it is a question of "mass of evidence," no one practitioner will have to be on the lookout for very many cases, and that it is only necessary to collect a dozen or more records which, when multiplied by the thousands of practitioners engaged in the work, and spread over a period of years, will furnish the required "mass of evidence."

It would be well to include in the curriculum the subject of clinical research, to be taught in the senior year, devoting to it about half a dozen lectures. This will be no burden whatever to the student, for it will require no preparation. Besides its direct effect in preparing him for research work, it will prove in general beneficial. From the very beginning, it will instil in him a sense of seriousness toward the significance of his future work, a factor of great importance. The lectures might include discussion of such topics as (1) importance of research; (2) value of clinical research in this connection; (3) keeping records of cases under investigation; (4) association of the graduate with some research organization; (5) relationship between the practitioner and the research laboratory of his school where he can get assistance in the form of specific direction and other aid, and (6) outlines for preparing reports for publication and presentation.

In a word, before the student leaves college, he should know at least that much regarding the value and methods of clinical research and his rôle in furthering it.

The benefits derived from the participation of the practitioner in the scheme of scientific investigation will be threefold: 1. To science: Sufficient material will be accumulated to render a definite conclusion regarding the relationship between oral foci of infection and systemic disturbance, the value and necessity of various therapeutic procedures, etc. 2. To the public: Roentgenographic examination will reveal many dental pathologic conditions which will require attention (this may be either preventive or curative in nature). 3. To the dental practitioner: Contacts with new people in connection with scientific research will have a far-reaching effect. First, it will direct the interest of the practitioner in a special field of scientific research which may prove a stepping stone to its further study. Undoubtedly, there are many practitioners who have both the ability and the inclination to do original research but lack the opportunity, and for them this investigation may supply the needed impulse. Again, it may bring a new interest to the daily grind and release the mind from the many irksome duties arising in the ordinary routine of daily work. Moreover, it will disclose to the dentist the relationship between dental and systemic conditions, thus creating a broader view of his work,

usually the result of any research activity in a special field. Finally, the keener interest of the patient will be aroused in the work of the dentist. Of course, no mention need be made of the pecuniary benefits that may accrue through added contacts of the dental practitioner with those he treats, since these are obvious and will doubtless repay his efforts many times over.

RÔLE OF THE SCHOOL IN PREPARING THE PRACTITIONER FOR CLINICAL RESEARCH

I have pointed out the responsibility of the school in preparing the student to participate in clinical research when he enters practice. This responsibility is met fully after the subject has been presented to him. The rôle which the school can play in this connection is not determined by the fact that it has given such a course, but is far greater than this responsibility and for the following reason. The training which the student gets in such subjects as, let us say, metallurgy, physiology, materia medica and chemistry, might be necessary for him to become a good practitioner. Nevertheless, there are many excellent men in our profession who have forgotten everything that they have studied about these subjects. More than that, one may be an outstanding man in his profession, not only after he has completely forgotten everything about such subjects, but even if he has developed a hatred for them. While this may be true in other relationships, such a condition should under no circumstances be permitted to occur as regards clinical research; for it must be borne in mind that the moment the student becomes indifferent to the subject of clinical research, the situation becomes hopeless. The subject of clinical research has to be taught differently from many others included in the curriculum. It must be taught with the object of arousing the greatest interest possible and developing a love for the subject. Fortunately, this could be accomplished with considerable ease, which cannot be said regarding other subjects of the course; which includes other types of investigations conducted by the various colleges. In Columbia University Dental School, for instance, students are given a course in research and, as Dr. Leonard points out in his paper "Building of Research Talent," presented before the general staff, the men write very interesting reports. He mentions topics such as "Effect of the Toothbrush on Gingivitis" and "Vincent's Infection in the Dog." This work requires a great deal of time both in preparation for the investigation and in writing of the report. Not every student is capable of such work. The particular students to which Dr. Leonard refers will probably remain or at least will devote a great deal of time in the future to laboratory research, joining the ranks of such investigators, but they are beyond the scope of the present discussion. If an average student who has no inclination for scientific investigation is forced to prepare some original work, two things will inevitably happen: he will completely fail in his task and will develop a complex in this connection, which, of course, will prove a catastrophe. The students must be allowed to take things easy when it comes to studying clinical research. Let them get the idea of it, let them develop an interest in it. Then, when they are out of school, the organization of clinical research will have good material to work with. The school will have played a very important rôle in training the future clinical investigator.

CONCLUSIONS

I do not claim to be the first to propose the participation of the general practitioner in scientific research. That was recommended long ago by Claude Bernard, and various attempts have been made in this direction by other writers, but all in vain. The point that I am making here is that every general practitioner cannot, under the existing circumstances, participate in research, even if his part consists only in directing attention to the clincial aspect of it, and unless these circumstances are changed, the attitude of the practitioner cannot be changed. In order to effect such a change, I have worked out a practical plan based on the study of the existing conditions and have thus evolved an entirely new concept of clinical research. My idea and the reasons are as follows:

The research work of each of the practitioners must not be isolated from that of his colleagues. The results must be that of a group rather than of individuals. The work must be so arranged that each individual worker should do the minimum not requiring much sacrifice of time or energy. This would be accomplished by assigning just a few cases in a certain space of time. The worker must be stimulated to action. This is accomplished through an organization which encourages the men to work. This is brought about through recognition of their efforts, guidance and assistance offered in all cases and at all times.

The training of the general practitioner for clinical research work must be done in the school that prepares him for his profession, for this cannot be practiced effectively without progress and progress is impossible without research, which is incomplete without the most extensive clinical investigation.

SUMMARY

It has been definitely established that clinical research as well as laboratory research is essential for the most satisfactory progress of dental science and art. To make clinical research effective, the general practitioner must take an active part. The participation of the general practitioner in clinical research was recommended by Claude Bernard as far back as the middle of the nineteenth century. Various attempts to stimulate activity in this direction have since been made by other writers, but in vain. Failure has been due to circumstances and unless these are altered success is impossible. To effect such a change, there must be established an organization that would stimulate the practitioner to proceed with scientific investigation, guide him in his efforts and correlate his findings with those of other workers. In order that the practitioner may be qualified to conduct research, he must be prepared for it by the school in which he is trained for his profession. Great care must be taken so to perfect his training that interest in, and love for, research will be developed, rather than a dislike, as is the case in other relationships, in the dental curriculum in certain schools.

342 Madison Avenue.

STATUS OF PRESENT DAY EDUCATION IN GENERAL ANESTHESIA*

By THOMAS CONNER, D.D.S., Atlanta, Ga.

THE administration of a general anesthetic is an undertaking not to be entered on lightly or unadvisedly. John Snow,[1] whose pioneer research on anesthesia made him one of the foremost anesthetists of his time, as early as 1851 pointed out that the safety of an anesthetic depended largely on the skill of the anesthetist. Many years later, Gwathmey[2] pointed out the same fact in these words: "To bring a living being to that borderland in which life in many respects so simulates death should at no time be a fool's occupation."

The death of Thomas Hobert,[3] the eighteenth patient to take a general anesthetic, forcibly reminded the fathers of anesthesia that they were dealing with a dangerous agent. Since this first recorded death from the use of a general anesthetic, each generation of physicians and dentists of every community investigated have had a patient die while under the influence of a general anesthetic, an unfortunate reminder of the grave responsibility of administering it. Miller[4] reported 80,483 nitrous oxid-oxygen anesthesias with two deaths, an average of one in 40,241. Teter[5] collected 938,924 cases under nitrous oxid alone, 32,172 cases with air, and 190,724 cases with oxygen, a total of 1,161,820, with only two deaths, a rate of one death in 580,710. In 1926, McKesson,[6] from replies to a questionnaire from 130 exodontists, collected 500,000 nitrous oxid-oxygen cases with forty-one deaths, a rate of one in 12,195.

Baldwin[7] (1923) thinks that nitrous oxid-oxygen is the most dangerous anesthetic, reporting fourteen deaths, and later six in addition, under its influence in the vicinity of Cleveland, Ohio. These statistics are called to your attention to remind you that patients continue to die under anesthesia.

Anesthetists of today realize that the success of their work depends largely on the degree of their skill. Every man of this time, if willing to spend a few months in postgraduate work, can acquaint himself in a most thorough way with the action of anesthetics and can acquire a definite understanding of the

*Read before the Section on Oral Surgery and Exodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 19, 1932.

1. Snow, John: Administering of Chloroform—American Journal of Dental Science, 1851.

2. Gwathmey, J. T.: Anesthesia (preface), New York: The Macmillan Company 1924.

3. Miller, Albert H.: Anesthetics, Their Relative Values and Dangers: Rhode Island, M. J. (supp.), September, 1931, p. 6.

4. Miller A. H.: American Year Book of Anesthesia and Analgesia, 1915, p. 107.

5. Teter, C. T.: D. Cosmos, 57:1028 (Sept.) 1915.

6. McKesson, E. I.: Cur. Res. Anes. and Anal., 5:64 (April) 1926.

7. Baldwin, J. F.: Correspondence, J.A. M.A., 81:948 (Sept. 15) 1923.

modern technic of administering them, their indications, contraindications and limitations. With this information at their command and with the greatly improved equipment—so superior to that of years gone by—anesthetists of today have a tremendous advantage over those of the past. It is generally conceded among anesthetists of the present time that any alert physician, dentist or registered nurse who is familiar with the physical signs of anesthesia, well drilled under a competent instructor in the general theory of anesthesia and has had wide practical experience may administer an anesthetic with a minimum risk.

Since the skill of an anesthetist plays such an important rôle in the success of anesthesia, would it not be well for the dental profession to take more interest in the method of instruction on this subject now in general use?

When the subject of education is mentioned, we first think of the schools of dentistry. Throughout the life of modern dentistry, they have been at the head of that great army of students who have advanced dentistry to its present high state of development; so we turn to them to find out just how much time is given to the education of their students and graduates in the science of anesthesia. At my request, the Atlanta Southern Dental College sent out a questionnaire to each of the thirty-eight dental schools of the United States. I shall present their reports at this time.

Question 1. Does a physician, a dentist or a graduate nurse administer general anesthetics in your department of oral surgery and exodontia?

Anesthetics are administered in six schools by graduate nurses only; in five schools, by dentists or graduate nurses; in two schools, by dentists, physicians or graduate nurses; in fifteen schools, by dentists only; in one school, by physicians only; in five schools, by physicians or dentists; in one school, by dentists or hygienists; in one school, by trained anesthetists only, and in one school none are administered.

Question 2. Is your professor of general anesthesia a physician or a dentist?

One school has a graduate nurse; eighteen have dentists only; ten have physicians and dentists; eight have physicians only, and one has no anesthetist.

Question 3a. Are your junior and senior students required to administer nitrous oxid-oxygen under the supervision of an instructor?

Seventeen schools require their students to administer nitrous oxid-oxygen under the supervision of an instructor; twenty do not require their students to administer nitrous oxid-oxygen and in one, the students' wishes are followed.

Question 3b. How many nitrous oxid-oxygen anesthetics are your students required to administer before graduation?

Twenty-one schools require none; nine schools require no definite number; two schools require from two to four; one school requires five; one school requires at least six; one school requires an average of five; one school requires an average of from ten to fifteen; one school requires at least two, and one school requires one or more.

Question 4. Do your students administer nitrous oxid-oxygen without the supervision of an instructor?

All schools answered no.

Question 5a. Are your students required to operate under nitrous oxid-oxygen anesthesia? (In my opinion, it requires more time to become an efficient operator under nitrous oxid-oxygen than to administer it.)

Twenty-one schools answered no; thirteen schools answered yes; two

schools answered occasionally, and two schools answered that it was optional.

Question 5b. If so, in about how many cases before graduation?

Twenty-one schools require none; nine schools require no stated number (optional); three schools require five cases; one school requires from fifteen to twenty; two schools require from ten to fifteen, and two schools require three.

Question 6a. Does your school give a postgraduate course in general anesthesia?

Thirteen schools give a course; twenty-four schools do not, and one school expects to give a course in the near future.

Question 6b. What is the duration of the postgraduate course?

One school answered usually one year; one school, one semester; one school, from two to four weeks; one school, four months; one school, three days; one school, eight months (oral surgery) full time, two years half time; one school, intensive one week course and an eight-weeks course; one school, two weeks; one school, one week twice each semester; twenty-five schools, none; three schools did not answer the question.

This survey makes it evident that our dental schools are not attempting to make anesthetists out of their students. The letters and notes accompanying the answers to the questionnaire lead me to conclude that most educators consider the science of anesthesia one to be acquired in graduate or hospital courses. We will agree, I am sure, that their position is correct. Some of the schools are not emphasizing to their students the fact that they are not qualified to administer a general anesthetic in their private practice until they have had an accredited graduate course in anesthesia. Men in our profession who are in a position to give advice should join with the schools in educating the profession at large as to the importance of this fact. Dentists, young and old, should be informed that they cannot learn how to administer anesthetics properly by seeing a few demonstrations or by taking a two or three day postgraduate course. Such training is totally inadequate and should be condemned. A little knowledge and an abundant supply of courage is a dangerous combination, especially when dealing with the well-being of our fellowmen, who are solely dependant on our profession as the guardian of the oral cavity.

Patients do not realize that there are good and bad anesthetists, or that a frequent cause of unsatisfactory anesthesia is the anesthetist's lack of knowledge as to how to administer the anesthetic properly.

There are far too many members of our profession who attempt the dual rôle of anesthetist and operator. In my opinion, in most instances, either the anesthesia or the operation is neglected, and the result is a dissatisfied patient. The standard of our profession should be raised to the point that the dentist who attempts to practice oral surgery or exodontia under a general anesthetic would at least be looked on with disfavor unless he has a trained anesthetist in attendance.

As a result of this investigation, I offer the following conclusions:

1. Recent graduates should definitely understand that a degree of doctor of dental surgery does not mean that they are anesthetists, nor does it bestow upon them the moral right to administer an anesthetic.

2. We should encourage every indi-

vidual who administers general anesthetics for members of the dental profession to obtain a certificate for an accredited postgraduate institution.

3. Dentists who operate under general anesthesia should have a properly trained physician, dentist or registered nurse administer the anesthetics.

FILLING THE PULPLESS TOOTH

By HOWARD TEMPLE STEWART, D.D.S., New York City

Legitimate dentistry consists of the preservation of the natural teeth in a healthy state to the end of life. . . . The reason that more is not known on this subject is because of the general belief that there is no money to be gotten out of it, and this idea necessarily closes the field of vision.—William H. Atkinson ("Transactions of the American Dental Association," 1869).

If a method could be devised of getting adequate surgical drainage, if the apex has been involved, and if a method could be found which would insure a higher percentage of successfully filled canals there would be a much higher percentage of favorable results. We feel that this problem is no longer our problem except as it concerns relatively unimportant details. This problem now belongs to the practicing dentist. Can he develop an accurate aseptic, scientific technic for treating and filling root canals upon the basis of a thoughtful selection of cases that will yield a high percentage of satisfactory results? We have proved that it can be done; and it is now your duty to carry on and to demonstrate whether or not this procedure is to be discarded except by unusually capable and conscientious practitioners, or to be reestablished in general favor.—Edward H. Hatton.

I know of one root that was filled just to the end. I know, because I held my thumb over it while filling the canal.—John R. Callahan.

In the March and October, 1930, numbers of THE JOURNAL and the November, 1930, number of the *Dental Digest,* I told of a new form of surgery and a new filling material for the pulpless tooth. I have had more than 300 cases.

Realizing what seems, from past methods, an impossible claim, it is with much hesitation but with the utmost confidence that I make these statements:

1. When permitted to do so, I have treated every case that was presented to me, no matter what the condition of the apical tissues from infection arising in the dental canal, and no matter what the age or systemic condition of the patient.

2. When I could definitely get through the foramen, every case that has remained with me and in which the patient has cooperated with me is a clinical success, as far as I can ascertain, except, of course, such cases as were manifestly hopeless from destruction of tissue or that were treated for experiment only. This does not mean that all were immediate successes —some required the filling to be removed and the tooth redrained, but each one has eventually regenerated and now gives clinical evidence of being healthy. (Figs. 1-4.)

In some cases, I made the grave mistake of pumping a thick paste of aristol and oil of cloves into the apical space and

Jour. A. D. A., November, 1932

then filling it. In these cases, redrainage was necessary, and this gave me much more trouble than any new case in which metal only was used in filling. It is indeed hard to conceive why I should have used this paste: perhaps it was the old obsession still clinging to me for combining an antiseptic or germicide or varnish with a filling. I found that the oil of cloves was dissipated, but the powder of the aristol itself remained unabsorbed,

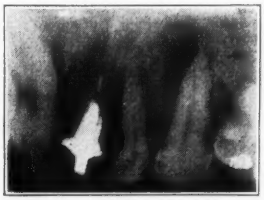

Fig. 1 (Case 1).—Cuspid showing large area of infection of several years' standing; irregular absorption of end of root, especially on mesial aspect.

Fig. 2 (Case 1).—Cuspid showing edges of foramen wall smoothed, with round bur through canal, leaving foramen funnel-shaped; copper rod inserted to stimulate drainage and regeneration; copper rods also in two perforations of long standing in central incisor. (Compare Figure 6, THE JOURNAL, March, 1930, p. 387.)

becoming foul from saturation with the body fluids, and preventing healing in of bony tissue. In two cases, it was actually thrown off by a fistula, but with no pain.

Julio Endelman, editor of the *Pacific Dental Gazette,* has called attention to the work of Roy. L. Moodie, under the title "Apical Closure of Root Canals in Adult Pleistocene Carnivora,"[1] which is exceedingly interesting. Moodie, a scientist, has found that the apical foramen closes entirely in the adult sabre tooth, the giant wolf, fox, dog, otter, bear and many wildcats. He does not know why the foramen closes. The pulp is retained and vital with no foramen or minute

Fig. 3 (Case 1).—Canal enlarged with larger copper rod in place. There is some clearing of the rarefied area.

Fig. 4 (Case 1).—Cuspid showing metal inserted with very slight pressure, allowing it to simply flow against soft tissue overlying very large opening. As can be observed, the metal does not go quite to the end of the root.

canals in the cementum to transit blood, nerve or lymph. Here, indeed, is food for thought for those who contend that a tooth is "dead" and a foreign substance

1. Moodie, R. L.: Pac. D. Gaz., 38:1 (Jan.) 1930.

when there is no blood, nerve and lymph supply from the pulp.

Dr. Endelman, referring to Moodie's work, says: "There is a wide-spread opinion in the dental profession that, if some reliable method were discovered or devised to insure the natural closure of the apical foramina, the root canal problem would be less of a problem than it now is."

"A method to insure the natural closure of the apical foramina" (presumably

Fig. 5 (Case 1).—Filling pressed higher up than in Figure 4.

Fig. 6 (Case 1).—Continued regeneration of bone.

with cementum) is, of course, "a consummation devoutly to be wished." But I fear there is little chance to do this. Nature, it is true, does sometimes close the foramen. Sometimes, closure is said to follow devitalization with arsenic; but for man to devise a method "to insure the natural closure of the apical foramina," even after extraction of a live pulp, is a remote possibility indeed; and to plan this for teeth with infected apical tissue would be fantastic. (I wish you to remember that about 90 per cent of my cases have been in this class.)

This statement of Dr. Endelman's presupposes, as being the general conviction, that if this foramen were closed, no infection could come from that tooth, and the apical tissue would be permanently healthy.

Now, if the foramen is definitely

Fig. 7 (Case 1).—Appearance of metal filling, showing change in shape, the result of compression of metal by tissues. One year elapsed between the taking of the roentgenogram in Figure 1 and that shown here.

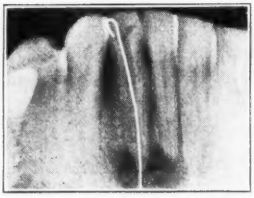

Fig. 8 (Case 2).—Extreme condition of lateral incisor with area extending around apex of central incisor.

closed artificially and the tissues heal and stay healed, is not exactly the same thing accomplished? Even the "fantastic" becomes reality. And here I wish to say that the method which I am advocating gives this result, and I believe it to be the only one that does. It is, I believe, the only method by which natural and

efficient drainage of the infected area is assured, and the only method by which, definitely and certainly, the foramen is sealed without irritation to the membrane or cancellous tissue.

A prominent and able dental writer has said, "I doubt very much if the human hand can ever acquire the necessary skill to make perfect root canal fillings without producing grave injury to periapical tissue."

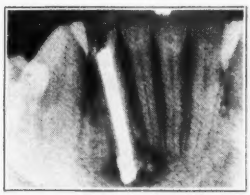

Fig. 9 (Case 2).—Progressive calcification of apical tissues after filling.

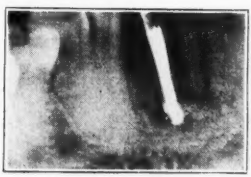

Fig. 10 (Case 2).—Progressive calcification of apical tissues after filling. This roentgenogram was taken about six months after filling.

If he means injury by the filling material, I will say that, with the filling material which I am using, "perfect root fillings" can be made and without "grave injury to the periapical tissues." If he means injury by instrumentation, I will say: The surgeon produces "grave injury," but he drains the tissues and gives Nature a chance to heal. Why have we always thought that the canal should not be opened and enlarged so that the bone can drain? The hypnotic influence of authority and the lack of a suitable filling for the foramen is the answer. What constitutes real drainage? It is not opening a canal and letting the tissue beyond drain, if it will, but *making* it drain. The condition of an open wound is quite different from what it would be if the surgeon had to drain the wound through a long open tube. We have to keep the tube cleaned for its entire length so that the wound will drain through it.

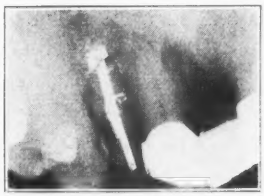

Fig. 11 (Case 3).—Accessory canal about middle of root.

Fig. 12 (Case 4).—Root nearly one half absorbed in infection of many years' standing. The area was found to be more extensive than is indicated here.

The tube is especially liable to clog at the foramen. As the secretions tend to solidify at and just within the foramen, the broach or cotton point must be carried entirely through the foramen, if necessary, at each sitting, until the drainage is complete.

"Mild septic inflammation is a strong stimulant of inflammatory osteogenesis. It causes widespread osteoporosis, increased vascularity, and abundant callus-

formation. This is the state in which cavities are most apt to heal."[2]

Hatton has repeatedly emphasized the fact that before we can hope to make the tissues healthy about an infected tooth, we must obtain drainage. He has been at a loss to know how this drainage could be obtained. He says: "If a method could be devised of getting adequate surgical drainage, if the apex has been involved, and if a method could be found which would insure a higher percentage of successfully filled canals, there would be a much higher percentage of favorable results."

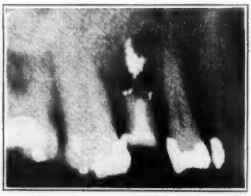

Fig. 13 (Case 4).—Canal and apical space filled with metal, a portion of which was removed for redrainage, the remainder, in the apical space, becoming encapsulated. The filling in the canal is only temporary (gutta-percha.)

Fig. 14 (Case 4).—Vigorous healing of tissue after continued drainage and in the presence of metal in apical space.

To me the way seems very clear: to enlarge the canal, open wide the foramen, incise the membrane, curet the tissue, set up an inflammation to stimulate excretion, free the foramen at each sitting from clogging secretions, wash out the apical space and stimulate the tissues with the spray, cotton points, hydrogen peroxid, etc., until the tissue can drain and heal.

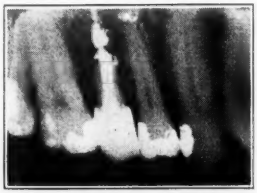

Fig. 15 (Case 4).—Completed case with perfect healing, the root carrying the crown with comfort.

Fig. 16 (Case 5).—Average infected case.

Fig. 17 (Case 6).—Average infected case.

Please remember that I am speaking here of infected apical areas (such as even the average root filling advocate extracts), and not of live pulp freshly extracted.

Copper rods, as already referred to,[3] are often used to obtain a sterile field, and to stimulate excretion and a reproduction of tissue.

2. Ochsner, J. A.: General Surgery, Philadelphia: Lea & Febigér.

3. Stewart, H. T.: Further Consideration of Pulpless Tooth, J.A.D.A., 17:1860 (Oct.) 1930.

Lately, Hatton (speaking of my work) has said: "Adequate drainage of the apical space is a thing that above all things is most desirable, and if teeth with infected apices are to be saved, the only way in which they *can* be saved." He says he believes that I "have accomplished adequate drainage of the apical space." I value this expression exceedingly, coming from one who has delved so deeply into the histology and pathology of the pulpless tooth and its surrounding tissues.

Drainage of infected bone is the first requisite, a cure being impossible without this, and there is no doubt that drainage of the apical space has here been accomplished. Granted this, it remains only to be proved that I have permanently sealed the canal with a material that is tolerated without irritation by the apical tissue and that healing constantly takes place in the presence of this material and these tissues remain in a state of health.

As this has been constantly and so abundantly proved by more than 300 cases during five years, with no discouraging aspects, I have the greatest confidence that it will finally be accepted by the profession as a means of treating infected teeth which cannot possibly be made surgically healthy by any other procedure now known. And here I will say that I solicit any *honest* criticism that may help establish the truth or error of my findings.

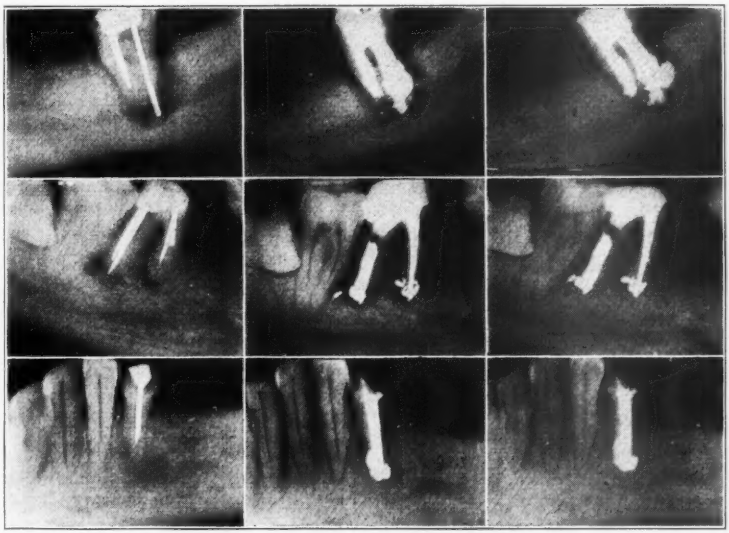

Fig. 18 (Case 7).—Clearing up of infection and progressive calcification, in three teeth in one mouth. In the case of the third molar (above), calcification is not yet complete, but a marked change has taken place. This is considered an extreme experiment, as the patient fully understands. The area around the bicuspid has calcified and healed against the metal. In the films to the left, the copper rods are in position.

As to the filling material (gold and

tin and mercury, or with platinum added), as far as I can see it has all the qualities of a root-canal filling that have been called for in dental literature and some others besides that have never even been mentioned.

And what are these qualities that have been called for and that this material possesses? Some of them are as follows (study them carefully and see how many of these are answered with guttapercha or with cements or pastes or with resin, or any filling with which you are familiar):

1. It shows in the roentgenogram better than guttapercha or any of the cements used for canal filling.

2. It is more easily and quickly removed from the canal than any other filling.

3. When it is necessary to remove the filling, the surplus remaining in the apical space does not interfere with drainage but promotes it.

4. No other filling material seems so well adapted for sealing a perforation in the side of the root. My experience is not yet extensive enough to speak definitely as to this quality, but, so far, results have been exceedingly gratifying. (Figs. 1-7, central incisor.)

5. It is readily and definitely carried in a small quantity to the end of the root, where, under very slight pressure, it flows out almost like liquid to lie against the walls of the canal and seal the foramen; it does seal the foramen, even if it is an inverted funnel.

6. It is carried to and through the foramen with no perceptible pressure from the instrument. The size of the plugger, which is considerably smaller than the canal, allows material to flow back down the canal from the apical space, as it is carried through by the plugger, thus leaving no pressure on the soft tissues.

I have repeatedly, in order to give it the severest test, packed the metal with pressure by confining it with a tight plug of cotton and packing firmly into the apical space. Even then there were no ill-results, no inflammation or after-trouble. Of course, I do not recommend this — it was done only for experiment — and even this does not send the metal out "into the cancellations." Neurohr says that even after the bony plate was removed, their curet carried it with only the slightest pressure of the curet into the cancellations.[4]

7. The material readily enters accessory foramina. (Fig. 11.) The slight pressure of the plugger on the mass in the canal carries the mercury in every direction. It must not be forgotten here that enlarging the foramen usually obliterates accessory foramina.

8. It is nonirritating and perfectly tolerated by the apical tissues.

9. In the apical space, it will yield to the slightest encroachment of regenerating tissue.

10. There is every clinical evidence that the presence of this material in the apical space stimulates cell action and promotes healing.

11. It is as impermeable to fluids as a solid ball of platinum or gold or tin or a bottle of mercury would be and it seals the foramen against leakage as well as if the tooth substance had been deposited and grown around this mass of metal. (To test this, fill any size glass tube, immerse in methylene blue any length of time and you will find it will not leak.)

12. It is the only filling material

4. Neurohr, F. G.: Is Infection the Only Danger in Root Canal Therapy? J.A.D.A., 18:97 (Jan.) 1931.

known that the tissues will perfectly and constantly encapsulate without irritation.

13. No other filling material will, without irritation, definitely seal the foramen and keep it sealed constantly as this will do.

14. No other material will pack out and exclude the moisture from the canal and at the same time prevent future leakage.

15. No other material remains plastic and moveable (without being permeated by body fluids) at the root end, allowing tissue to displace it and grow in around the root end.

16. No other material will carry over the foraminal wall edge, double back against a denuded root end and seal off this end from the organism as this does. Remember that (1) not nearly so many root ends are denuded as we have been led to believe, and (2) by opening the foramen for drainage as advocated in infected cases with rarefied areas, the denuded area is usually entirely obliterated. Where denudation actually does exist, the tissue cannot grow in and displace the material. On the contrary, it grows against the top and sides of the metal, holding it closely against the denuded area, and shutting this area off from the adjacent tissue. (Figs. 5-7, 13-15.)

There seems a general misunderstanding of the nature of the material. Remember that the surplus that is in contact with apical tissue is exceedingly mobile, plastic and absolutely nonirritating, giving readily to the slightest encroachment of the tissues in healing. (Figs. 12-15.) This is described in the article by Neurohr.[4]

The filling is nonirritating, because it is so plastic that it gives to the slightest movement of the apical tissue. Because it allows healing in, over the end of the root, and because it is perfectly compatible, after healing it seems a part of the tissue itself. In hundreds of cases, there seems no tendency of the surplus material to move after healing has once taken place, but it moves most readily during the healing process, and adjusts itself to the surface of the healing tissue. After this is once thoroughly understood, I feel that this material can but be universally adopted. It must be used practically in order to understand its qualities. The results are then little short of miraculous; but this cannot be understood by reading or theorizing. For experimental fillings in extracted teeth and glass tubes (which I earnestly advocate), tin and mercury alone may be used without gold or platinum. In fact, I have filled several teeth with this mixture and they have done well, but it is not to be recommended since it sets slightly and no filling material that sets can be assured complete tolerance in the apical tissue. The very movement of the tooth in mastication would cause a set material to be irritating to the apical tissue.

Bear in mind that the material assumes many and sometimes surprising shapes and positions while the tissue is growing in about the root end. Instead of moving so as to show space between it and the root, it sometimes takes the form of a hood, while the tissue, also in the form of a hood, grows in underneath it to cover the end of the root. In this way, as can readily be seen, the roentgenogram would not show the separation of the material from the end of the root.

Let me once more emphasize the fact that I believe metal mercury to be the most nearly perfectly tolerated metal that can be put into the tissues. A pound may be given at one dose with

no effect except from its mechanical presence in the stomach. It is, in its substance, as compatible as gold or platinum or tin, and, withal, moves like water to the slightest pressure, conforming perfectly to whatever shape the healing tissue tries to assume. Remember that the material that passes through the foramen is much softer than that which remains in the canal, and contains a greater proportion of mercury.

One thing that "closes the field of vision" is aversion to the work of opening root canals.

The opening and enlarging (thus cleansing) of canals is the chief part of the story. When they are enlarged, they are cleaned, and when they are enlarged, they can be filled, accurately filled, and not till then. And when they are accurately filled, the foramen is sealed, and when the foramen is sealed, the apical tissue ceases to be infected by the canal or tubules.

Men generally have thought so much in terms of guttapercha or cements that they cannot grasp the idea that the well-opened foramen can be filled successfully—of course, it cannot be done with guttapercha or cement—but can be done perfectly with a permanently plastic metal. But this is work and worry and nerve strain and is not always remunerative. Here, I will say briefly that, in addition to the gold-tin-mercury mixture, for some time, I have been using an admixture of platinum. The platinum addition gives a more sticky and plastic mass and is very penetrating under slight pressure. It is more like a soft paste.

I have also used platinum, tin and mercury without gold. These mixtures work excellently in the canal and apical spaces. The clinical results so far are ideal. In addition, I have also, in some extreme cases, added a small admixture of copper to these materials, about 2 per cent of the mass. Of course, as yet I have no way of knowing whether the addition of copper is advisable in any case. Copper alone causes aseptic superficial suppuration of tissue with which it comes in immediate contact, while stimulating a reformation of tissue (especially bone) immediately in contact with the area of superficial suppuration. It also acts as a germicide. For these reasons, I conceived the idea[3] that copper rods might be the best means to drainage and sterilization of the field about an infected apex, at the same time stimulating a regeneration of tissue. So far, the results entirely justify the procedure and cause me to believe that there may be a future in general surgery for the sterilization of wounds and areas of chronic infection with copper.

The copper does not become saturated or diluted with body fluids, nor is it weakened by them in its bactericidal or stimulative power. Its effect is constant and permanent.

Several times, the rods have caused very rapid healing of fistulous tracts. F. E. Beyer, of this city, reports the same result from copper rods.

The case of a 9-year-old child is interesting and illustrative. A fall killed the pulp of an upper central incisor. A fistula formed and had been discharging for three months, this in spite of constant treatment by one of the most skilled operators of my acquaintance, who referred the patient to me. Notwithstanding the drainage through the fistula, as well as the tooth, a sickening odor was present. To my astonishment, this did not diminish with treatment with medicines pumped through the fistula and sealed in the canal, nor did the discharge cease. There was a blister-

like swelling, the size of a pea, at the orifice of the fistula. I continued the treatment for six weeks with no improvement. It now occurred to me to try the copper rod. At the end of one week, the pea-like blister was gone, the discharge had ceased and there was no odor. In two weeks, all trace of the fistula had disappeared. To be safe, I kept the rod in for one month longer, removing, draining and replacing it once weekly. The canal was then filled and the result after more than two years seems perfect.

As I intimated in my previous paper, I realize that it is entirely too early to speak of the use of copper with certainty, but if my fellow dentists will help me experiment with it, we may find that we have something of much value.

I will appreciate hearing from those who try this.

To return to the filling: When using any cement, any form of guttapercha or varnish or any other filling so far advocated, we cannot disregard the fact that we cannot perfectly seal the absolute end of the canal without some overfilling, and this makes an impossible obstacle with the usual root-canal filling materials; but with my exceedingly plastic metal, which in the apical space is practically as pliable as mercury itself and remains permanently so,[5] it is quite different, because the material is perfectly tolerated and allows the tissue to grow in about the apex.

The material carried through the foramen and in contact with the apical soft tissue is much softer than that in the canal. As the material is added, that in the canal has much of the mercury expressed from it and becomes firmer, slightly wedging in the canal as the mercury is expressed toward the crown, while the metal in the apical space is "softer than what we term a 'sloppy' mix of amalgam."[4]

Neurohr expresses pleasure in the working qualities of the material in the following words: "Imagine my surprise when I found the material in an extremly plastic state although it had been in place for over a year." This affords me also the greatest pleasure, it being one of the points that I have been anxious to impress on my readers but have not been able to prove, as I have had no opportunity or occasion to extract teeth and enter the bone in such a manner to test my theory of the permanent plasticity of the metal. Unfortunately, my patients have been too much attached to their teeth to allow me to do this, and then, too, I didn't have the heart to do it, especially with teeth like these that he extracted which I could open and redrain (if necessary), making of them perfectly good teeth.

Of all the teeth that I have filled like these, I could not bring myself to extract a single one. Dr. Neurohr extracted three of five teeth that I had filled and removed the buccal plate and entered the cancellous structure in his new experiment. He says of the qualities of my filling material: "The slightest pressure with the curet, although full access had been secured by the removal of the buccal plate, would squeeze this material into the cancellations of the alveolar process." If this is true, this metal must have the ability to enter small accessory foramina. (Fig. 11.)

After extracting three teeth in this manner, Dr. Neurohr decided that this was sufficient and determined to use the other two teeth that I had filled to support a bridge, believing it safe to leave this foreign material (which was

5. Footnote 4, p. 98.

considered so dangerous for the other three teeth) in the two teeth needed to support the bridge.

Many men insist on sealing the tubuli with varnish or resin before filling the canal. This presupposes leakage of the filling. If the filling does not leak, there is no reason to employ varnish; and if it does leak, the varnish will be liable to disintegration wherever exposed, and thus a final breeding ground develops.

Men who are still concocting cements containing antiseptics or are placing metal points or guttapercha points with any kind of varnish or antiseptic cement or paste are only following out the ideas that have obtained since before the average practitioner was born, in a vain attempt to seal the foramen definitely. For instance, oxychlorid of zinc alone or in combination with metal points, also with cotton shreds, were used more than sixty years ago; and, incidentally, although these have long since had their day, I believe oxychlorid of zinc to be a better tooth saver now than any other known material except the one I am now giving to the profession.

I sincerely trust that I will offend no-one in this statement; for some of our ablest men are working along this line and producing good results; if men will not carry out my treatment, by all means let them carry out the others. I mean to say that it is not possible by any of these methods to save many teeth that can be saved by my method, while any teeth saved by their method can also be saved (and with much more certainty) by mine.

In regard to my filling material, I wish to call attention to this point: If the filling needs to be removed, it is not because of irritation of the material to the tissues, but because the tissues have not had sufficient drainage or time for healing, the stoppage of the secretions causing trouble.

The filling is so easily removed to reestablish drainage that one need have little fear of pain that cannot be quickly relieved.

I wish again to voice a warning against filling small canals because (1) they cannot be easily and perfectly filled with any material (not even this one) and (2) drainage of infected tissue is impossible. Generally speaking, the buccal roots of molars should be enlarged, at least with the No. 6 file, and all other canals considerably more, in proportion to their size.

When I recount so many good points of this material, and no bad ones, I am reminded of the English real estate auctioneer. There seemed to be no end of splendid advantages and qualities in the estate that he was offering. In the midst of his oratory it finally dawned on him that he was listing so many good qualities without mentioning any bad ones, that the audience might be unfavorably impressed, so he said, "Gentlemen, I must admit there are two serious drawbacks to this wonderful estate — the litter of the rose leaves and the noise of the nightingales."

If anyone is able to convince me and show that I do not think or act right, I will gladly change, for I seek the truth, by which no man was ever injured. But he is injured who abides in his error and ignorance.

—Marcus Aurelius.

COMMENT ON CASES ILLUSTRATED

Imagine filling the inverted funnel shown in Figure 3 (Case 1) with guttapercha or cement or any kind of varnish or paste with a metal point and sealing it against leakage. Imagine the result if this inverted funnel were filled with any kind of filling yet advocated except the permanently plastic metal with which this was filled. Imagine the contact of any of these materials with the peria-

pical tissues. Only disaster could result. Picture the permanently plastic metal, which fills up the funnel-shaped foramen and lies against the soft tissue beyond, adjusting itself to any movement of this healing tissue.

In Figure 5, a cotton piston was pressed against this material in the pulp chamber carrying up the entire mass. This resulted in a slight pain from the pressure and the compression of the soft tissue, but this passed away in a few hours and there have been no disagreeable symptoms since.

The central incisor in Case 1 has two perforations, of two years' standing, distal and palatal to the foramen, with pain, swelling and escape of pus by the gum margin. These perforations were evidently made in an attempt to drill through the foramen or drill the canal to accommodate a crown post. The distal perforation was quite large and the tissues were badly infected. I filled this with great misgiving, but the tooth has done well.

In Figure 3, only a small amount of the metal was gently smeared in, in an effort to obtain an outline of the perforation. It was fully filled later as shown. The pressure of the healing tissues has changed the shape of the metal at the ends of both these roots.

Some of my roentgenograms have been criticized as showing some "infection" after filling. These teeth are filled before calcification takes place, and are expected to show uncalcified areas (but not infection) after filling until they have had time to clear up. Observe the change in this case (Fig. 3).

In the type of case shown in Figures 8-10, we expect complete calcification, probably in from six months to one year.

In Figure 12, the canal was widely opened, and the foramen made funnel shape by use of a round bur hooked over the foramen wall at the apex, as illustrated in Figure 6, THE JOURNAL, March, 1930, page 387. The cutting of the end of the root in Figure 6, referred to above, is excessive and was done on the extracted tooth only to show that any portion desired of a root can thus be cut away from the apex downward.

In Figure 14, the presence of the metal in the apical space, I believe, stimulated healing.

Perhaps nine out of ten infected cases would be about like those illustrated in Figures 16-17.

In Figure 18, clearing up of infection and progressive calcification are shown in teeth whose response to this treatment would indicate that the successful handling of the average pulpless infected tooth is child's play.

DENTAL AND GENERAL HEALTH CONDITIONS IN RELATION TO DIET*

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I HAVE always been inclined to look on dentistry as one of the highly specialized fields of medicine, in much the same category as cardiology, gynecology, urology, gastro-enterology or obstetrics, for it is the work of the dentist to care for those organs of the human body whose condition and function predicates not only the state of subdivision of ingested food, but also, in many instances, the normality of secretion and activity of the digestive juices. I feel some timidity in addressing men within such an important specialty, despite the fact that of all dental fields, yours probably exhibits the closest and, at the same time, least understood relationship to general health.

From the time of the development of the common dental germ, at about the seventh week of fetal life, to the date of eruption of the last third molar, the

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orthodontic problem may be present. With the various deformities found, and the causes to which they are ascribable, you are doubtless much more familiar than I. It seems, nevertheless, a rather definitely demonstrated fact that nutritional disturbances of one or another form in mother, infant and child play an important and perhaps decisive rôle in the anomalies present.[1]

Long before the biochemical changes associated with pregnancy were known,

Table 1.—Faulty Health Habits, in Eight Hundred and Thirty-Four Students (After Emerson)

	Per Cent
Fast eating	72
No rest periods	69
Irregular habits of living	42
Irregular time of bowel movement	42
Irregular bedtime	37
Eating when overtired	33
Injurious health habits	30
Overdoing at work or play	28
Uncontrolled likes and dislikes	23
Worry and fretfulness	22
Irregularity of meal times	21
Inadequate annual or weekly vacations	19
Finickiness about food	17
Eating of candy or sweets between meals	17
Insufficient exercise or outdoor sunlight	17
Uncorrected physical defects	14
Working in poor air at temperature above 68 F	12
Excessive use of tea, coffee, or tobacco	12
Habitual overeating or undereating	11
Sleeping with closed windows	7

and many years prior to the development of our knowledge of the effects of sunlight on nutrition, or of the necessity for vitamins in the diet, medical authors gave many lengthy descriptions of the longings of pregnant women for natural and unnatural foods. Havelock Ellis [2] extracts a few graphic descriptions from the writings of Schurig:

> Some women have been compelled to eat all sorts of earthy substances, of which sand seems the most common, and one Italian woman ate several pounds of sand with much satisfaction, following it up with a draught of her own urine. Lime, mud, chalk, charcoal, cinders, pitch, are also the desired substances in other cases detailed. One pregnant woman must eat fresh bread from the oven in very large quantities, and a certain noble matron ate one-hundred-forty sweet cakes in one day and night. Wheat and various kinds of corn as well as vegetables were the foods desired by many longing women. One woman was responsible for twenty pounds of pepper; another ate ginger in large quantities; a third kept mace under her pillow; cinnamon, salt, emulsion of almonds, treacle and mushrooms were desired by others. Cherries were longed for by one, and another ate thirty to forty lemons in one night. Various kinds of fish, mullet, oysters, crabs, live eels, etc., are mentioned; while other women have found delectation in lizards, frogs, spiders and fleas, even scorpions, lice and flies. A pregnant woman, aged 33, of sanguine temperament, ate a live fowl completely with intense satisfaction. Skin, wool, cotton, thread, linen, blotting paper, have been desired.

Table 2.—Phosphorus and Calcium in Diets of Several Peoples

	Daily Ration in Grams	
	Phosphorus	Calcium
Bushmen, Eskimos and Maoris	2.038	0.600
Batongas	2.239	0.328
Civilized: North America	1.236	0.980
South Africa	1.096	0.993

These unusual nutritional cravings of the pregnant state serve only to illus-

1. Höjer, A.: A Method for Determining Antiscorbitic Value of a Foodstuff by Means of Histological Examinations of Teeth of Young Guinea-Pigs, Brit. J. Exper. Path., 7:356 (Dec.) 1926. Howe, P. R.: Effect of Diet on Teeth and Bones, J.A.D.A., 10:201 (March) 1923. Shibata, M.: Effects of Lack of Vitamins on Development of Teeth. Japanese J. Exper. Med., 9:21 (Feb. 20) 1931. Lennox, Joseph: Notes on Phosphorus Deficiency as Cause of Dental Caries, Items Int., 52:693 (Sept.) 1930.

2. Ellis, Havelock: Studies in Psychology of Sex, Vol. 5, Erotic Symbolism, etc., Philadelphia: Ed. 1, F. A. Davis Co., 1906, p. 211.

trate the profound metabolic changes taking place at such a period, and the tremendous influence these may have on the yet unborn child. The proper development of the fetus from the embryo apparently depends on them. For example, alterations in all or any portions of the nasofrontal process, or in the maxillary and mandibular arches, may take place as a result of improper nutrition at this period; and, in like manner, changes in the eruption and nutritional state of the teeth postnatally are predicated on these intra-uterine conditions, as well as on the metabolism of the infant and the child.

Table 3.—Effect of Food Deficiencies on Teeth

Vitamin	Function	Chief Sources	Tooth Tissues Most Affected	Condition Present
A	Antibacterial Antixerophthalmic Antiedemic	Animal Fats Green vegetables	Enamel Dentin Cementum	Rapid degenerative changes in enamel cells Atrophy of astrocytes, and adamantinoblasts Osteoid dentin
B	Antiberiberic Antineuritic Antipellagric	Seeds of plants Eggs Yeast	None	
C	Antiscorbutic	Fresh fruits	Pulp Periodontal membrane Gingival tissue	Degeneration capillary endothelium Hemorrhage Dentin rarefied, thin or lacking
D	Antirachitic	Animal fats Green vegetables	Enamel Dentin	Odontoblastic layer and dentin matrix normally formed but improperly calcified

As I think I shall be able to show later, the assimilatory deficiencies causing the loss of human teeth are for the most part identical with the deficiencies underlying orthodontic problems. Caries and periodontoclasia are the conditions for which 96.62 per cent of all extractions are performed. The remainder are accounted for by impactions, cystic conditions, the presence of supernumerary teeth and accidents. It is quite significant that caries and pulp disease show their ravages most markedly in the growing period from 7 to 20 years of age. Periodontoclasia appears later in life, and is more common in men than in women. It is further interesting to note that, in mouths showing a great deal of caries, there is little or no periodontoclasia, and vice versa.

Now caries and periodontoclasia are for the most part preventable diseases, as are also the prenatal disturbances in the dental germ, which afford a con-

genital background for the tooth irregularities that you are called on to treat. The obstetrician, the pediatrician and the general practitioner of medicine should all play a large rôle in minimizing the likelihood of occurrence of these defects. The fact remains that none of them do very much about it. I am convinced, therefore, that the orthodontist will justify his position as a medical specialist of the highest order by noting certain facts routinely at the first visit of the patient. Where his services have already been sought in a family, he should see to it that subsequent children come under his care prenatally. In so doing, he will perform an invaluable service for the families that he attends, and these will in turn recognize in him not simply a high grade mechanic, but a highly trained health specialist.

Good nutrition would seem to me to be the keynote of preventive dentistry. Good nutrition in any human being depends on four fundamentals: food, air, rest and exercise. The importance of regulating these four essentials is well illustrated in Table 1, compiled by the Boston pediatrician Emerson,[3] on the health habits of 834 students. Concerning food, Hanke[4] says, "The indications are that caries can be arrested by proper feeding." Emerson shows that 72 per cent of his series are fast eaters, 33 per cent eat when overtired, 21 per cent have irregular meal times and 17 per cent are finicky about food and eat candy and sweets between meals, 11 per cent either undereat or overeat and 12 per cent indulge excessively in tea, coffee or tobacco.

TABLE 4.—FOODS HIGH IN CALCIUM AND IN VITAMINS A, C AND D

Milk: calcium+vitamins A, C and D	Buttermilk	
	Cauliflower	
	Dried eggs	
Spinach: calcium+vitamins A and C	Dried beans	
	Boston brown bread	Calcium
Dandelion greens; eggs: calcium+vitamins A and D	Maple syrup	
	Celery	
Cheese; carrots: calcium+vitamin A		
	Milk bread	
Fresh peas; lettuce: vitamins A, C and D	Wheat kernel	
	Liver	
Tomatoes; raw cabbage; peaches: vitamins A and C	Kidney	Vitamin D
	Brains	
Butter: vitamins A and D	Heart	
	Fish roe	
Turnips; lemon juice; raspberries; apples: vitamin C	Cocoanut	

The proper oxygenation of the body through corrective exercises and a sufficiency of circulating air is a *sine qua non* to a normal nutritional state. In his survey, Emerson found 12 per cent of his subjects working in poor air at tem-

3. Emerson, W. R. P.: Dentist and Health Diagnosis, D. Cosmos, 72:1147 (Nov.) 1930.

4. Hanke, M. T.: Rôle of Diet in Cause, Prevention and Cure of Dental Disease, J. Nutrition, 3:433, 1930.

peratures above 68 degrees F. Seven per cent were sleeping with closed windows.

Unwillingness or inability to rest plays a great part in the general well-being of the individual, and the vitality of any and all of his or her organs. we find that 69 per cent of the persons studied took no rest periods, 37 per cent were entirely irregular in their time for going to bed and 22 per cent tended to worry and fret.

Exercise is essential for normal posture, good muscle tone and healthy skin

TABLE 5.—FOODS RICH IN PHOSPHORUS

More than 0.400%:	Per Cent		Per Cent
Meat extract (solid)	2.800	Egg yolk*	0.524
Cottonseed meal*	1.193	Beans, kidney (dry)*	0.475
Meat peptin	1.130	Almonds*	0.456
Linseed meal*	0.741	Chocolate	0.455
Mustard*	0.755	Lentils*	0.438
Cocoa*	0.709	Barley (entire)	0.400
Cheese*	0.683		
Between 0.300 and 0.400%:			
Peanuts	0.399	Hazelnuts*	0.354
Oatmeal	0.388	Paprika	0.341
Liver	0.358	Lima beans (dry)	0.338
Walnuts	0.000	Pecan nuts	0.335
		Shredded wheat	0.324
Between 0.200 and 0.300%:			
Brains	0.266	Graham bread	0.218
Pepper, white (dry)*	0.233	Beef (lean—20% protein)	0.216
Buckwheat flour	0.226	Brown rice	0.207
Between 0.100 and 0.200%:			
Currants (dried)	0.195	Macaroni	0.144
Cow meal	0.190	Lima beans (fresh)	0.133
Pepper, black (dry)*	0.188	Raisins	0.132
Boston brown bread*	0.185	Peas (fresh)	0.127
Barley (pearl)	0.181	Farina	0.125
Eggs	0.180	Sheep's milk*	0.123
Caviar*	0.176	Brussels sprouts	0.120
Buckwheat flour	0.176	Figs, dried*	0.116
"Entire wheat" bread	0.175	Bacon	0.108
Oysters	0.155	Mushrooms	0.108
Cocoanut (dried)	0.155	Prunes	0.105
Rye bread	0.148	Pomegranate	0.105
Hominy	0.144	Goat's milk	0.103

*More than 0.100 per cent calcium.

Hanke [4] describes a case of a pregnant woman (one of three failures out of sixty-three cases treated by his routine) in whom, in spite of diet, exercise and fresh air, caries remained uncontrolled because of worry and loss of sleep. Referring again to Emerson's [3] analysis, and other appendages, such as teeth. From Table 1, it is obvious that a certain percentage of people (17 per cent here) have both insufficient exercise and outdoor sunlight; that 28 per cent of this series overdo at work or at play, and that 14 per cent have uncorrected phys-

ical defects because of improper attention to normal body activity.

When one is confronted with irregularities in health habits as above enumerated, in a stratum of society presumptively well above the average in intelligence, one should clearly perceive the grave necessity for a greater consideration of these essentials on behalf of the health of the teeth as well as of general body conditions. With these things in mind, I here suggest data which should occupy a place in the record of every dental patient. Such information, which is easily and quickly obtainable, makes possible an intelligent appraisal of the patient's general nutritional needs.

Weight.—Thyroid and pituitary insufficiencies are usually associated with overweight, and often accompanied by delayed or imperfect dentition. The dentist will do well to insist on the cooperation of the physician in such cases. If there is underweight, malnutrition and malassimilation may be the cause. The dentist may expect to find varying degrees of caries, and imperfect tooth ridging, "spotty" enamel or even noneruption. Weight alone may afford him the proper key to dietary management, medical consultation and orthodontic procedure.

Measurements.—Is height in proper relationship to weight, age and sex? Is there normal chest expansion? Do upper and lower body spans correspond? Are there abnormal abdominal measurements?

Fatigue Posture.—Is it present or absent? The person who assumes normal posture, even though with effort, soon finds such a carriage much easier than a posture allowing him to slump into such a position that all the vital organs are displaced, and their blood and nerve supplies placed under stress.

Muscle Tone.—This is a very excellent gage of the state of nutrition and affords a key to the relative amounts of food, air, rest and exercise the individual is getting. Simple palpation of arms and legs affords ample information in this particular.

Health Habits.—I have referred to Emerson's work [3] on this subject. I believe one should ask: "How often and how rapidly do you eat? What exercise do you take in the fresh air? How do you sleep? How frequent and regular are the bowel movements?"

Local Causes of Oral Deformity.—Little need I remind those engaged in the practice of orthodontia of the necessity of taking cognizance of a high arched palate, hypertrophied turbinates, abnormal ear drums, diseased tonsils, deviated septums, infected sinuses, etc. Such knowledge would seem essential before any attempt at dental corrective measures.

Past History.—If the patient is a child, it is most important to ascertain whether the mother's pregnancy proceeded normally, i. e., was there excessive nausea and vomiting? Was there kidney complication? Did the teeth soften? Was labor abnormal?

Regarding infancy and childhood, one may ask, "Did the child have scarlet fever, diphtheria, typhoid fever, pneumonia, or small-pox? Has he had convulsions?" The former produce decided retarding effects on the growth of teeth as well as other structures. The latter may suggest rachitis with its attendant maldevelopment of teeth, delayed or prolonged dentition and the eruption of faulty teeth.

A well-trained secretary may make note of six of these seven items in from two to four minutes, and may thereby

save the dentist many months of unsuccessful labor, and the patient unnecessary discomfiture and expense.

When one attempts to analyze the dietary deficiencies presumed to cause abnormal dental conditions, one is confronted with a maze of conflicting opinions and with a vast literature on experimental material, clinical and laboratory, supporting this or that theory. I shall mention only a few:

One of the earliest is Miller's[5] famous lactic acid bacillus theory, according to which there is a direct action of organic acids on the tooth structure, with subsequent decay.

J. Sim Wallace's "detergent diet theory," [6] a logical outgrowth of W. D. Miller's famous work, postulates that bacterial fermentation is retarded or prevented by the use of cleansing foods, particularly at the end of a meal. Bunting *et al.*[7] apparently concur in this theory. Ruffer's study [8] of the teeth of ancient Egyptians, who lived on a very rough, detergent diet, rather conclusively refutes this theory, as these same peoples suffered a great deal from caries as well as from attrition. Their dental troubles were more probably the result of vitamin C deficiency. Moreover, Hanke[9] has shown that gingival inflammatory processes are eliminated by supplying an abundance of vitamin C in the face of careless cleaning and even of bacterial infection. Dental caries is simultaneously arrested.

Mellanby's concept [10] of dental caries practically represents the idea of vitamins A and D deficiency. She contends that if these two vitamins are present in sufficient quantity, in the presence of enough calcium and phosphorus, and a normal amount of sunlight or its actinic rays, dental caries will be arrested and perfect tooth structure favored. A great deal of her work has been done with tuberculous children, who are notoriously in need of these particularly nutritional substances. Her theory has a wide acceptance.

Howe,[11] Hanke [4] and numerous others whom the latter quotes tend to consider vitamin C deficiency the most basic dietary lack in poorly formed or subsequently carious teeth. In so doing, Hanke and Howe do not fail to mention the possible rôle of other factors in the changes they discuss.

Lennox's "phosphorus deficiency theory" [12] ignores any but the relatively low phosphorus content of the civilized dietary as the basic cause of dental malformation and decay. He bases his theory upon a comparison of the phosphorus content of south African native diets with the diets of settlers and of north Americans. (Table 2.) An element of truth certainly seems to exist in

5. Miller, W. D.: Micro-organisms of Human Mouth, Ed. 1, Leipsic: Georg Thieme, 1892.

6. Wallace, J. S.: Detergent Diet Theory of Prevention of Dental Caries, Items Int., 52:357 (May) 1930.

7. Bunting, R. W., et al.: Problem of Dental Caries, Am. J. Dis. Child., 40:536 (Sept.) 1930.

8. Ruffer, M. A.: Studies in Paleopathology of Egypt, Ed. 1, University of Chicago Press, 1921, p. 268.

9. Hanke, M. T.: Relation of Diet to General Health, J.A.D.A., 17:957 (June) 1930.

10. Mellanby, May, and Pattison, C. L.: Action of Vitamin D in Preventing Spread and Promoting Arrest of Caries in Children, Brit. M. J., 2:1079 (Dec. 15) 1928.

11. Howe, P. R.: Effects of Scorbutic Diets on Teeth, D. Cosmos, 62:586 (May), 921 (Aug.) 1920.

12. Lennox, Joseph: Observations on Diet and Relation to Dental Disease, Items Int., 52:110 (Feb.), 285 (April), 361 (May), 623 (Aug.), 693 (Sept.), 924 (Dec.) 1930.

this theory when one recognizes the fact that the minimum daily phosphorus requirement of the normal adult is 1.32 gm. Price [13] takes a much broader view of the mineral deficiency theories, recognizing the part played by vitamins and vitamin activators. His work with animals on various types of pasture shows, nevertheless, that phosphorus and potassium are the most widely fluctuant minerals in the grasses and in the blood of animals. His studies go farther and also establish conclusively the relationship existing between dental retardation and caries and vitamin intake. In 200 tested individuals using cod-liver oil, raw and activated, and activator concentrates from dairy products, he finds, from six months' observation, ten times as many cavities in those not receiving activator concentrates as in those who did receive them.

Whatever our theories relative to retardation in development and growth of teeth, and to the cause of caries and other dental disease, we are continuously brought face to face with the fact that any disturbances of the teeth (barring mechanical) have a systemic origin, and must be treated accordingly.

There are a large number of conditions determining growth, and any or all of these might influence dental development directly or indirectly. I may illustrate the point nicely by referring to protein deficiencies, such as in actuality occurred during the Civil War in some of the southern troops, who were forced to live at times entirely on corn meal. Under ordinary circumstances, no diet is actually lacking in any of the essential amino acids, nor in a variety of adequate proteins.

We do have to consider, on the other hand, vitamin A, C, and D deficiencies, as well as calcium and phosphorus intake in making any detailed study of the requirements of the particular dental patient.

The data obtained at the patient's first visit as above described suggest the general nutritional needs. Let us now study the dental conditions which a diminution in one or more of the vitamins may induce. (Table 3.) It will be observed that vitamins A and D predominately affect the hard structures of the teeth, while vitamin C deficiency shows itself in changes in the vascular structures: pulp, periodontal membrane and gingiva. Vitamin B apparently is not essential to the life and health of the teeth. Note further that vitamins A and D are always found together in nature and were for a time thought to be identical; i. e., a single vitamin rather than two distinct ones. In discussing these sources, I would remind you that vegetable oils, nut butters, and lard do not contain vitamins A and D. The prolonged or sole use of butter substitutes should therefore be forbidden, or where economically necessary, must be offset by the ingestion of sufficient quantities of cod-liver oil or eggs or fish roe.

The patient cannot be too frequently reminded that vitamin C is destroyed by heating, and that therefore canned vegetables have little if any of it present. Canned fruits usually retain some of this vitamin owing to the acid content, which tends to preserve and protect this substance. But the great bulk of this vitamin should be obtained from fresh fruits, of which lemons and oranges are most richly endowed.

Phosphorus and calcium changes in the teeth are known to go hand in hand with vitamin A and D variations, and are found in nature in greatest abun-

13. Price, W. A.: Control of Dental Caries, J.A.D.A., 18:1189 (July) 1931.

dance in foodstuffs containing these vitamins.

To amplify further the vitamin and mineral-bearing foods of value to the dentist and particularly to the orthodontist, I have tabulated the foods rich in calcium and in vitamins A, C, and D. (Table 4.) It is obvious that no well balanced diet should be lacking in any of these particulars, but one must always keep in mind the necessity of feeding vitamin C without heating the foods in which it is found. Realizing that human rachitis is of the low phosphorus variety, and despite Karshan's[14] work showing that otherwise normal low phosphorus diets affect the bones but not the teeth appreciably, I also append a list of foods high in phosphorus. (Table 5.) Karshan observed that when there is a deficiency of both calcium and phosphorus, the teeth suffer greatly, and I have starred phosphorus-containing foods which are highest in calcium content. It must be further remembered that, other things being equal, phosphorus rich foods are also vitamin A and D rich foods.[15]

To make these dietary suggestions more concrete, I have set down here the essentials of a daily ration that, as far as we know, contains all of the factors necessary for health: milk, from 1 to 2 pints; meat, varying in amount inversely with the amount of milk; lettuce, from one-fourth to one-half head; lemons, juice of one; oranges, one-half pint juice (juice of two, large); fresh vegetables and fresh fruit, any desired amount.

I can close this informal talk perhaps in no better way than to quote Hanke of the University of Chicago.[9]

Although the dietary management has been useful as a mode of treatment, it should be advocated most strongly as a preventive measure. Dietary management should most certainly begin with the pregnant woman, not only because of the most immediate effect on herself, but also because of the action on the fetus. Subsequent proper systematic nourishment of the child may lead to a decreased incidence of oral inflammation and possibly of dental caries.

SUMMARY

1. Disease states and the nutritional condition of fetus or expectant mother influence the appearance and character of dental abnormalities as well as those noted in other tissues.

2. Caries and periodontoclasia are the most common immediate causes of the loss of human teeth.

3. The nutritional disturbances causing caries and periodontoclasia are probably also responsible for conditions demanding orthodontic care.

4. The orthodontist, the obstetrician and the pediatrician should cooperate in the prevention of dental abnormalities.

5. Food, fresh air, rest and exercise are necessary for nutrition.

6. The dentist may ascertain the nutritional status of his patient by a brief record, containing notations of weight, certain body measurements, posture, muscle tone, oral and perioral conditions and essential past history.

7. Theories as to the dietary deficiencies presumed to cause tooth abnormalities have been advanced by Miller, Wallace, Mellanby, Lennox, Price, Howe and Hanke.

8. Dental conditions are associated with deficiency of one or more of the essential foodstuffs.

9. The daily ration of foods necessary to supply all the elements for good health are easily available.

14. Karshan, Maxwell: Calcification of Teeth and Bones on Rachitic and Non-Rachitic Diets, J. D. Res., 10:267 (June) 1930; 11:64 (Feb.) 1931.

15. Macleod, J. J. R., et al: Physiology Biochemistry in Modern Medicine, Ed. 6, St. Louis: C. V. Mosby Co., 1930, p. 822.

ORAL DIAGNOSIS*

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THE recognition of disease has always been considered as one half of the cure, while the failure to identify disease may result in inability to afford relief to our patients. Dentistry is called on more and more to help in the identification of pathologic conditions, particularly in those cases of obscure etiology. We all know the effects on the practice of dentistry of the criticisms offered by Hunter and others that dental conditions were acting as a focus of infection, with resulting systemic involvements. These criticisms have been accepted by the dental profession and attempts have been made to offset them.

Oral diagnosis involves recognition not only of dental disease but, more important, the identification of those conditions or symptoms which may be present in the mouth but are of general systemic origin.

The daily routine of the dental office has to do for the most part possibly with the recognition of those conditions with the symptoms of local pain. In fact, the dentist is known to the great mass of the people only as a person to apply to for the relief of toothache.

In looking over our school library for material and suggestions as to an oral examination, I was surprised to find no outlines that were broad enough to be of service to me. In the daily routine of clinical experience in a school like ours, with close affiliation with the medical department, we are called on to render an examination possibly somewhat dissimilar to that required in the general practice of dentistry. Our cases require a check up of ailments involving the eye, ear, nose and throat and in fact any condition that would suggest a possibility of a focus of infection as an etiologic factor in the pathologic condition.

Oral examination may be classed under the following headings as to purpose: (1) for the relief of pain, (2) for esthetic reasons, (3) for the evaluation of health; and under the latter heading we may have the subgroupings (*a*) when a pathologic condition is present, (*b*) when a symptomless pathologic condition is present, and (*c*) for the assurance of health.

When the patient is in pain, he will seek a dentist for relief. This serves as an introduction, and of course it is the dentist's duty to relieve the pain as quickly as possible. The important service that can be rendered is to suggest a complete examination of the oral cavity. The examination for the relief of pain should be considered a preliminary one and should involve the inspection of the surfaces of the teeth, the pulp and the periodental membrane. Sometimes, under this heading, we may have to aid in the location of causes for reflex neurosis and other types of neuralgic pain, but, on the whole, this examination should be con-

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sidered simply as a preliminary inspection.

From the esthetic point of view, we may be called on for an examination for the correction of malocclusion, for the restoration of lost teeth. In fact, any of the specialties of dentistry, including operative dentistry, prosthetics, orthodontia and exodontia, may be grouped under this heading. This examination will be touched on later in this paper.

An oral diagnosis evaluating the general health calls for the highest type of oral examination, and I believe that every patient should at certain intervals submit to a very rigid examination. This examination should be conducted in such a manner that a complete contact is made with the medical profession in order to evaluate the health of the individual. If the functions of the oral cavity are interfered with, a complete dental and medical survey should be made, and this statement is in complete harmony with the theories of preventive medicine.

Improvements in examination methods are constantly being introduced and advancements are being made from time to time in the technic of a physical examination, and there is no question that a complete physical examination will demand a survey of the mouth. The teeth are not simply adventitious structures, but are subject to the same changes as are found in the general metabolism of the body.

In contrasting the serious oral examination with the examination of the teeth for cavities, how often do we hear our medical confrères complain about our examinations as too superficial. We must accept the responsibility of the dental examination with the same degree of seriousness that the medical man should accept a case referred by us for a medical check up.

In the past, dentistry has been accused of being too superficial in her teaching of the basic sciences, particularly the medical sciences, pathology, bacteriology and biochemistry, as these are of great importance in a thorough physical examination. This condition may have existed some years ago, but, at the present time, I am of the opinion that the dental profession is better prepared to interpret the physical findings. I also believe that the importance of the dental organs is being appreciated more and more and they are not regarded as easily dispensed with and easily replaced. As there seems to be a tendency toward complete cooperation between the medical and dental professions, a harmonious agreement may be reached in the deciding of this question of dental health rather than the medical profession's assuming attitude of the court of last appeal, as has sometimes happened.

Some seem to think that a roentgen examination of the mouth is all that is necessary, and even then the diagnosis of a roentgenographer who has not even had the advantages of direct contact or inspection is taken as authoritative in some of our diagnoses.

To show that a harmonious relation can exist, I would like to cite the relationship between the dental clinic and Dr. Howard and his associates in the department of ophthalmology. This clinic will not operate in ophthalmologic cases unless the dental department gives the patient a clean bill of dental health. The dental recommendations must be submitted to by the patient. To me, one of the most important phases of a physical examination is the discovery of symptomless condition. To make a direct application: We frequently find on roentgenographic examination teeth that are a menace to the patient's health. We also see the early stages of carcinomatous

conditions. I recall one month in which four cases of early cancer were recognized, although they were symptomless, and of course if we had failed to make a careful examination the life of the patient would have been shortened. We have also had cases in which the symptoms were so mild that they were being neglected by the patient, he thinking that only a minor oral condition was present. In this category, to quote from actual clinical experience, we could class such conditions as leukemia, anemia and diabetes, all having presented early symptoms in the oral cavity.

I would like to see the dentist consider his position seriously in the general health service and look on mouth conditions as more than simply mechanical defects requiring restorations, recognizing that behind the teeth is a living human being.

When we need the assistance of our medical friends to aid in this assay, we should feel perfectly free to send our cases to him for his advice and expect full cooperation, with a report. We hear too frequently that the members of the medical profession complain of our lack of cooperation, and possibly there is some ground for complaint. On the whole, the patient invariably leaves the dentist and follows the advice of the physician. This is not as it should be as far as the dental organs are concerned. It is a known fact that the majority of physicians are poorly informed as far as dental pathology is concerned, and most of them base their opinion upon a set of roentgen-ray films, which, to my mind, does not qualify them to pass on dental conditions.

In considering the etiology of oral disease, I am going to enumerate some important facts that I feel should be stressed. A thorough family history should be obtained, and sometimes some very important information is brought out, including hereditary influences, habits and family peculiarities. I have found several hemophiliacs, and, to illustrate hereditary influences, strange to say within two weeks, three patients were brought in suffering with almost a complete hypoplasia of the enamel, almost an agenesis. All of these cases gave a history of family peculiarities almost identical. The parents were what you might call freaks, contortionists, and all of them possessed the ability to dislocate their joints at will. These cases were from different families and from different locations. Of course, we find also syphilitic taints, which may also influence our diagnosis. The manner of living and the residence, giving information as to local surroundings, diet, occupation and change of environment are of importance. We have all seen the effects of change of environment, of moving from one country to another, with the loss of immunity.

PAST HISTORY OF ILLNESSES

It is surprising the number of syphilitics we meet with. Some cases presented for treatment included young boys 6 and 8 years of age, and because of their symptoms, they were sent to the children's clinic. Both of these came to us for treatment supposedly for trench mouth and our suspicions as to the presence of syphilis was substantiated. Three adults, on cross questioning, brought statements from their physicians that they were being treated for syphilis. In a peculiar case of arthritis deformans of four years' standing, the oral cavity was absolutely negative, with no devitalized teeth, the only past disease being a case of cystitis about six years previously. I cite certain case histories simply to emphasize some of the topics in an oral examination that

may be of particular importance and that are sometimes neglected.

As the present condition of the teeth and their examination is generally gone into thoroughly by most operators, little need be said on this subject. There are two conditions that I should like to stress. First, we should not lose sight of the fact that the dental condition, caries, etc., may be the result of some predisposing condition, and if this is not eradicated, the simple mechanical restoration will not place this mouth in a serviceable condition for long. To further stress this point: The simple filling of cavities should not be expected to correct deficiencies as in diet, and also maladjustment to environment. Second, we should not forget to examine persons 45 years of age and older for irritating surfaces on the teeth, as such irritating surfaces may be a factor in chronic irritation that may result in the production of neoplasms in the mouth.

Under examination of the teeth, we might list the following topics: teeth missing, loose, opaque, impacted, discolored, abraded, eroded, malformed, pulpless, filled, crowned, bridged, fractured. The simplest way of recording this information is to use a "no" or "yes," and with a check mark record the condition as found. In the same manner, we might chart the condition of the soft structures of the mouth, such as the lips, cheeks, tongue, palate, pharynx and salivary glands. The conditions of the teeth as to pathologic processes, including the pulp, may be grouped into the various degenerative changes, as simple pulpitis, dry gangrene and moist gangrene. It is not my purpose to go into a complete description of every phase of a general examination, but I would like to stress certain phases. In examining for caries, as to involvement of the pulp, etc., a vitality test should be used, and whichever one is most convenient for the operator, such as heat and cold, electricity or transillumination, may be made use of.

The vitality of the teeth should receive our consideration, as, at times, owing to trauma, a pulp will die, and such a test will be required to uncover this condition. By some, a pulpless tooth without the involvement of the periapical region is considered as a menace to health. The recognition of pyorrhea alveolaris is to my mind one of the most difficult diagnoses that we have to make. At what stage does this condition begin? We might regard the retreat of the gingiva as an indication, but we all know that this point is movable, and like all other conditions, this one has a certain normality depending on the age. As far as the conveyance of infection is concerned, I have set an arbitrary point which is not dependent on a roentgenographic examination. I find frequently that the roentgenogram will show conditions of pyorrhea far less serious than exist in the mouth, and again there are times when the resorption of the crest of the alveolar process has occurred to a considerable extent and there is still little if any pus on palpation of the gums. So I am of the opinion that we should base our decision regarding pyorrhea conditions (1) upon the presence of pus, and (2) upon a hyperplastic condition or an increased thickness of the periodontal membrane.

The fate of pulpless teeth is open to debate. As far as the dental examination is concerned, I am convinced that this is one of the most important topics at the present time: When should these teeth be extracted? In practicing conservative dentistry, we do not like to record ourselves as being 100 per cent for the ex-

traction of pulpless teeth. No one for a moment will doubt that the teeth may act as a menace to the general health, but there are many teeth extracted that could have been retained and have been a great aid to the patient in the recovery of health. Although the removal of all pulpless teeth, based upon the theory that they are infected and that removal would possibly prevent a metastic infection, seems to be sound practice and may be justified as a step in the elimination of a symptomless pathologic process, I am still opposed to such a procedure.

We have cases that call on the masticatory function of the teeth for the proper preparation of food for the building up of health, which our most satisfactory mechanical substitute does not seem able to perform. I will admit that, many times, this ruthless extraction of teeth leaves the mouth in such a condition that the prosthetists find it an almost hopeless task to replace the lost organs. To me, this is a crime, and I wish that I might arouse more of the profession to a serious consideration of this subject. Remember that when we view a darkened area or a radiolucent area, if we follow the case and submit it to treatment, we are very prone to consider that a certain amount of time will be required for bone cells to be redeposited and, with the permission of the patient, and with a proper check up, we should consider it our duty to attempt to save these teeth. I am convinced that a great many teeth are being extracted just because they are pulpless and without sufficient evidence that there are infections about the apex and that they are serving as a source of infection. I believe that, if figures were accumulated to prove the benefits accruing from the extraction of all of these teeth, we would find that, in a great many cases, more harm has been done as a result of the extraction than would have resulted if the teeth had remained in position. The suggestion has often been made that if these patients are in a condition to have extraction to the extent that might be indicated and all of the pulpless teeth are removed, we may overwhelm the patients and, in some cases, place their life in jeopardy.

Let us make our oral examination as regards the pulpless tooth very critical and attempt to find out its bearing upon the general health of the patient, rather than closing our eyes and saying that the tooth is an insignificant member of the body and that its sacrifice will not be felt. The same holds true in the case of pyorrhea: let us be more conservative and examine our cases with the hope that a favorable prognosis may be rendered more often than has been the custom in the last few years. Just what knowledge may be necessary for a decision to save teeth of the latter type depends entirely on our observation. I have seen many pyorrheic teeth brought back to a degree of health that was beyond our expectation by a little care and cooperation on the part of the patient.

I do not believe that we should consider the case hopeless just because of an acute attack of some general systemic disorder. We should rather base our decision more upon some of our general findings. To continue the examination: Smears of the mucous membrane of the mouth, cultures from the root canal and analysis of the saliva as to its p_H, also its viscosity, may be of advantage at times. As regards the information that should be furnished us from the medical profession, I might briefly enumerate the following: blood pressure, blood count, at times the blood calcium determination, and, of course, the heart sound, which is of particular interest to us.

The blood count, particularly of the white cells, showing us that a leukocytosis is present, which is indicative of a general systemic infection, is of particular interest. As time progresses, we will find that urinary analysis as to glucose and albumin is important. In fact, as we make progress in our knowledge of physical examination, we may apply more general findings in our diagnosis.

The purpose of this paper is to emphasize the importance of an examination, both oral and otherwise, as a health service. I wish to stress also my feeling that a more conservative attitude should be assumed regarding the pulpless tooth, extracted when it is pathologic, but allowed to remain when there is doubt. The same holds true for pyorrheic cases. I believe that a person with a general debilitating disease or with such a condition as arthritis deformans can enjoy life much better when he can use his own teeth than to be without the teeth and have the same general systemic symptoms that we so often see.

CONCLUSION

I wish that I might stress the point that we want to cooperate to the utmost extent with the medical profession in the eradication of the foci of infection, but we would rather devote our time to cooperation with them in an attempt to farther advance preventive dentistry, as we feel that this branch of dentistry is entirely within the hands of the physician. Let us continue the thorough examination of teeth and establish the evidence that mouth symptoms and general systemic symptoms are one and the same and, by their correlation, we shall better serve mankind.

TREATMENT OF THE DENTAL PULP CANAL*

By ALFRED WALKER, D.D.S., New York City

THE subject of pulp-canal treatment, one of the most interesting phases of dental science, embraces one of the most important fields in the practice of dentistry. Contributions to this subject have been numerous, in both its clinical and its research aspects.

I shall not attempt to deal with the latter, but will confine myself to a consideration of the clinical aspect. Let me say that, in this field, we must consider both the operative procedures involved and the results of pulp-canal operations as evidenced in the biologic response of tissues both immediate to and remote from the field of operation.

This is a point which brings in, in a certain sense, the research aspect, since it is only possible to judge the final value of a system of treatment by following up the cases treated, both with regard to roentgen-ray evidence of possible periapical tissue change and the state of the general health, from the focal infection standpoint.

Dentists are prone, because of the mechanical nature of much of their work, to judge operations from that standpoint. Yet in pulp-canal treatment, the opposite

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

must be the case. Regardless of the mechanics of pulp-canal treatment and filling, the final test of its success must be the general health of the patient. This fact is often lost sight of. Dentists follow one operator after another, inquiring as to technic and methods of medication, with the apparent feeling that, if they can only learn some new method of manipulation, their operations will be uniformly successful.

I hope that this paper, if it does nothing else, will succeed in impressing on those who hear it that correct technic, important as it is, is secondary to the proper evaluation of biologic conditions.

At the outset, then, we must have a suitable record of both local and general conditions. In addition to making an examination of the tooth itself, including adequate roentgen-ray photographs, we must have in our record the patient's age and medical history. Of course, this history must be obtained from the physician. It is not enough to take the patient's word as regards his past and present state of health. For one thing, the patient, in his anxiety to save the tooth in question, will frequently assert that his health is good when he knows the reverse to be true. Also, the physician, for good and sufficient reasons, may withhold from a patient information as to some systemic condition which would be properly regarded as a counterindication to pulp-canal treatment. Incidentally, it may be of interest to this audience to know that, during the past few years, I have noticed a decided change in the attitude of physicians with whom I have consulted regarding patients for whom I have considered performing pulp-canal operations.

In former years, physicians not only have been anxious to have the pulpless teeth of their patients removed, but also have consistently advised against performing pulp-canal operations even when the evidence indicated that the teeth were free from infection. At the present time, I find them, as a group, more conservative in this respect and evincing a decided interest in such operations and their results.

Let me introduce the subject of pulp-canal treatment by stating the types of teeth to be considered for this operation. We have, first, vital teeth with nearly exposed pulps or pulps recently exposed. Following this, we list teeth with pulps which have partially or completely lost their vitality. Infected pulpless teeth should be given consideration since, in favorable cases, satisfactory results may be obtained. I would stress the types of cases in which the percentage of success may be sufficiently high to give satisfaction to the operator.

Here again, it may be well to call attention to the fact that the dentist accustomed to performing operations whose success depends almost wholly on the mechanical perfection of his work is apt to look to this same ability for success in pulp-canal treatment. We must ever keep before us, in this work, the fact that we are dealing with highly vascular tissue, whose reaction to injury and infection is dependent, to a considerable extent, on the systemic condition of the patient. Success can be attained only when this factor is correctly evaluated.

As a help in determining this, may I offer a formula which I have found most helpul:

PULP-CANAL THERAPY—CLASSIFICATION OF PATIENTS

Type 1. Under 30 years of age, good health, vital pulps and absence of clinical or roentgen-ray evidence of apical bone involvement.

Type 2. Under 30 years of age, good

health, vital or nonvital, clinical or roentgen-ray evidence of slight apical bone involvement.

Subtype *a*. Moderate apical bone involvement.

Type 3. Over 30 years of age, good health, with conditions as in Type 1.

Subtype *a*. The same, with conditions as in Type 2.

Type 4. Poor health, regardless of age.

Subtype *a*, Type 3, should be carefully considered as subjects for pulp canal treatment. Those in this group who have passed well beyond the age of 30 may be considered as risks. All related factors should be carefully evaluated.

Type 4 should always be rejected.

ITEMS OF INQUIRY REGARDING PATIENT'S HEALTH

The family history, personal history as to recurrent inflammatory or debilitating disease and present health, with the history and the location of the tooth are the object of the dentist's inquiry.

This is not offered as a universally applicable gage, but simply as a guide which may be of considerable help in this aspect of the work.

Naturally, we begin with diagnosis. This includes tests of vitality, especially the electric, and a roentgenogram of the tooth to be treated. In the case of a pulpless tooth, in which the routine roentgen-ray examination reveals no evidence of periapical involvement, two additional exposures are made at different angles in order to verify this condition.

After these steps, the tooth itself is investigated to determine the condition clinically. Occasionally, teeth which are negative in the roentgenogram will, when opened, be found to have so extensive an involvement of the pulp-canal walls, as evidenced by discoloration, as to indicate a hopelessly infected condition of the dentin. This condition may even be found in teeth having vital pulps which have been infected for a long period of time.

This condition should be emphasized as it occurs quite frequently and is always a counterindication to treatment. Those cases in which the pulp-canal walls are involved may give good results at the time of the operation but, almost invariably, will show unmistakable signs of periapical infection at a later time.

At this point, I should like to mention the so-called strategic tooth. Dentists are frequently confronted with a situation in which a tooth that has great potential value as an abutment for a restoration, or which occupies a conspicuous position in the mouth, is found to require pulp-canal treatment. In making a diagnosis of such a tooth as regards its suitability for this treatment, it is essential to exclude consideration of its strategic importance while making the decision as to whether it should be treated. The dentist's judgment is too apt to be swayed with regard to such teeth, if he allows himself to dwell on the desirability of saving a tooth.

Some pulp-canal operators advise against the treatment of multi-rooted teeth. I should like to call attention to the fact that the biologic factors in the treatment of such teeth are exactly the same as in the case of single-rooted teeth. The only difference is in the mechanical factor involved in gaining access to the canals and in treating them properly when once they have been opened. This is a question of personal skill in most instances, although the awkward placing of a tooth may contraindicate attempts to carry on this work.

I have referred to the fact that both mechanical and biologic factors enter into the question of the success of pulp-canal

operations. This fact should always be kept in mind. A perfect surgical technic will surely fail if the biologic factors are not properly evaluated, and it is also true that the operator who may gage these factors correctly will fall short of success if this technic is faulty. Our success in providing substitutes for lost tooth-substance is to the everlasting credit of the profession, but that very success constitutes a hazard in the pulp-canal field, because our patients look to us to attain equally satisfactory results in this field. It is well to explain to the patient, when the question of a possible pulp-canal operation is being considered, that we are now dealing with a totally different phase of dental work, and that the dentist is frequently confronted with conditions which are beyond control under the most nearly perfect technic.

It is not my intention to describe a definite technic for the treatment and filling of pulp canals. This has been adequately done by many other workers in this field. I do consider it important to lay down certain principles which must be observed if we are to have success in this work. As regards asepsis, of which so much has been said, there are several contributory conditions which are often overlooked. Not only do we need to use the rubber dam and to work with surgically clean instruments, but also the entire organization of the operating room must contribute to the maintenance of an unbroken chain of asepsis. Everything with which the operator's fingers or instruments may come in contact must be scrupulously clean, and the chair assistant must be carefully trained to aid in the protection of all accessories from contamination. As a further aid in this, I should also like to mention the necessity for undisturbed concentration on the operation in hand during the time that the pulp canal is open. The operator should not permit himself to be called from the operating room or called to the telephone, or to be otherwise interrupted.

I shall not dwell on medication, nor shall I recommend any particular type of therapeutic treatment, but I should like to emphasize the fact that dentists are prone to depend on medication in pulp-canal treatment, and to regard this as the primary factor in success. Of course, it is wise, between treatments, to place a fairly strong germicide in the canal as a safeguard against infection. I might add that a tooth should never be left open between treatments, as this is a violation of surgical principles. It is my belief that when the tooth is properly handled, it can always be hermetically sealed without injury.

It is my custom to seal in the canals a very minute amount of disinfectant. This leads me to the observation that because we are working with the rubber dam in place, it is permissible to use strong chemicals, especially in the pulp chamber, for purposes of immediate sterilization of the dentin. The important thing is the surgical technic rather than the medication.

When we come to the filling of the canal, we find it important to lay down as the fundamental principle the hermetic sealing of the entire canal. This means not merely the insertion of a guttapercha cone, but also the condensation of this material against the sides of the canal throughout its length. No substitute for this condensation can be considered satisfactory.

With regard to the point that I have just made, I should like to comment on the partial pulp-canal operation, or, in other words, the partial removal of the

pulp, with subsequent filling to the point where pulp tissue still remains. In performing this type of operation, the dentist is warned that he must not exert pressure against the pulp tissue remaining in the canal. It is my contention that, unless pressure is exerted, the pulp-canal filling will inevitably fail to make contact with the pulp-canal walls throughout their entire length. Any space so left will certainly invite seepage, and will provide for the introduction of infection at some future time, with resultant failure of the operation.

At this point, I should like to mention the treatment of pulp canals in deciduous teeth. From the enumeration of the principles that I have laid down, it will be evident that I do not consider the filling of pulp canals in deciduous teeth a proper procedure. The shape of the canals, particularly at the foramen, renders it next to impossible to seal the canals hermetically throughout their length, and, with the changes which go on as the roots are absorbed, the maintenance of a seal is increasingly disturbed. Therefore, it is impossible to maintain a sterile condition in such teeth, and much harm may result therefrom. In the effort to compensate for these recognized weaknesses, operators oftentimes depend on antiseptics incorporated in the root-canal fillings placed on these teeth. That this is a fallacy will be evident when we consider that the potency of a germicide is dependent on its concentration. The environment of the root which is undergoing absorption is such as to bring in contact with it a certain amount of fluid from the osteoclastic tissue. This will constantly tend to dilute the antiseptic in the canal and thereby lower its potency.

How shall we gage the success of our operations? In times past, it was quite sufficient to have comfort, or, in other words, freedom from pericementitis. Also, the disappearance of any symptoms of chronic inflammation immediately following the completion of the pulp-canal filling. We must now set up a standard which can be satisfied only by a sense of comfort immediately following the operation plus a continued state of health both periapical and as regards the general condition of the patient over a long term of years. It will be understood that I am referring here to symptoms of focal infection and that evaluation of such symptoms, if they do occur, must be based on a study of other possible foci which may be found in other parts of the body.

Dentists often regard the filling in of bone in a periapical area as an indication of the success of the operation. This condition is to be accepted with some caution, as these areas sometimes show a subsequent secondary breaking down. This is an indication that a case has been poorly selected, the treatment having succeeded in temporarily ameliorating what was actually a hopeless infection. Furthermore, I wish to warn against a feeling of satisfaction with areas of rarefaction surrounded by zones of condensation. These are often interpreted as an indication of a walling off of the infected area.

The significance of this walling off is debatable, but it is to be noted that, in some instances, the dense bone itself eventually breaks down and itself becomes rarefied; which indicates an extension of the infection.

Lest it be thought that I place entire reliance on the indication of freedom from infection afforded by the roentgen-rays, let me say that cases frequently occur in which teeth negative in the

roentgenograms have been found to be infected. This is particularly to be considered in cases of focal infection. While we do not necessarily extract roentgenographically negative pulpless teeth in such cases, we must be prepared to do so if the physician is unable to find foci of infection elsewhere in the body. When such foci have been eliminated in patients suffering from focal infection, the extraction of roentgenographically negative pulpless teeth frequently gives most gratifying results.

CONCLUSION

I can only repeat, in brief, some of the points that I consider important in this field: 1. The selection of the tooth to be treated. Here, the diagnosis must include consideration of the condition of the pulp and of the pulp-canal walls, the periapical condition and the age and health of the patient. 2. The maintenance of a rigid asepsis during operations on the tooth and the thorough cleansing of the canal. 3. The complete filling of the canal, with thorough condensation of the filling material against the walls of the canal. 4. The subsequent check-up of the case, over a considerable period of years, as to local conditions and the health of the patient.

100 West Fifty-Ninth Street.

PATHOLOGY, DIAGNOSIS AND TREATMENT OF THE PULP AND PREPARATION OF ROOT CANALS FOR FILLING*

By EDGAR D. COOLIDGE, B.S., D.D.S., M.S., Chicago, Ill.

MUCH has been written during the last two decades about the problem of the pulpless tooth and its relation to general health. The attitude of many in the profession during that period has passed from the extreme of saving teeth that should have been extracted because of incurable conditions in the periapical area to the other extreme of extracting all pulpless teeth and even those whose pulps required treatment. The removal of a pulp by accepted surgical methods offers as great possibilities of a successful outcome as almost any surgical operation or any other dental operation. That a tooth of a young person should be extracted just because the pulp has become exposed is one of the worst blots on the escutcheon of dental practice in history.

INFLAMMATORY CHANGES IN THE PULP

The changes in the pulp due to inflammation may be divided into the acute, chronic and degenerative conditions. The acute conditions are those that have painful symptoms and usually force the patient to seek dental service. The two acute conditions most common are a partial pulpitis and a suppurative pulpitis. It is difficult to determine when

*Read before the Section on Operative Dentistry, at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

*From the Research Department (director, Rudolph Kronfeld) of the Chicago College of Dental Surgery, Dental Department of Loyola University.

a partial pulpitis has its beginning as the symptoms of discomfort in eating or sensitiveness to thermal change come on gradually and become more and more intense as time goes on. According to the studies of Fish,[1] there is a pulp disturbance that takes place as soon as the enamel has been penetrated and external agents either mechanical or chemical are thus allowed to make contact with the living protoplasm in the dentinal tubules.

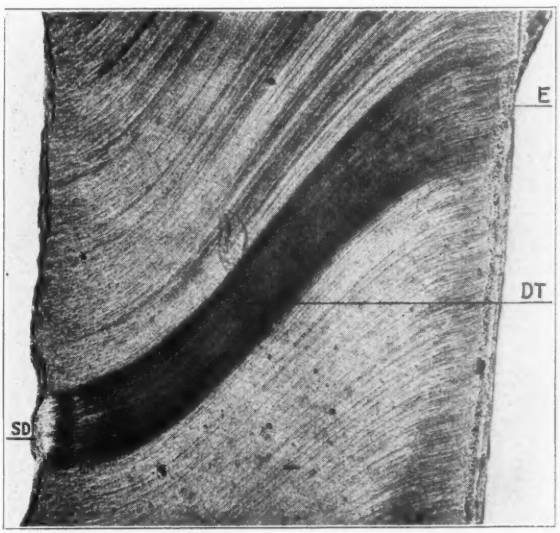

Fig. 1.—Unstained ground section of human tooth. *E,* erosion at cemento-enamel junction. *DT,* dead tract (Fish) in the dentin. *SD,* secondary dentin on wall of pulp chamber covering ends of tubules contained in dead tract caused by exposure. (Illinois State Dental Journal, May, 1932.)

The response to this irritation, conveyed by means of the contents of the dentinal tubules, is first a stimulation of the pulp cells to lay down additional hard substance (secondary dentin) immediately over the pulpal openings of the dentinal tubules involved in the superficial decay or injury (Figs. 1-3). If the process develops rapidly or a sudden exposure of many tubules occurs, as in a fracture, the pulp cells are not able to produce the protective layer fast enough to protect the pulp tissue from irritating influences, and increased and painful symptoms develop, known as acute partial pulpitis.

The foregoing description in no way refers to the clinical exposure of a healthy pulp. This condition is not one of a pathologic nature. When the healthy pulp is slightly exposed with only a superficial injury, when decay has not been the cause of the exposure, there is a possibility of healing of the pulp in children if the roots are not completely formed, but a very much smaller chance

1. Fish, E. W.: Physiology of Dentin and Its Reaction to Injury and Disease, Brit. D. J., June, 1928.

after that period. Pulp capping[2] has been practiced with gratifying results in many carefully selected cases. Perhaps the greatest factor in the success of pulp capping lies in selecting only those cases in which the pulps have not been infected through dental caries. In the case of approaching caries, pathologic changes in the pulp take place long before there is an exposure, and it is not always possible to determine these pulp changes from clinical symptoms; hence, pulp capping is an uncertain procedure when deep caries is present.

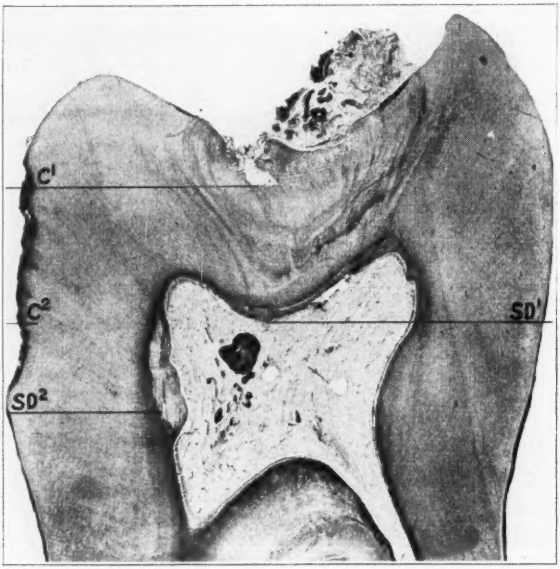

Fig. 2.—Occlusal and approximal caries in molar crown. C^1, occlusal caries. C^2, approximal caries. SD^1, secondary dentin corresponding to C^1. SD^2, secondary dentin corresponding to C^2. *D*, denticle. (Illinois State Dental Journal, May, 1932.)

ACUTE PARTIAL PULPITIS

In the pulp which is in a state of partial pulpitis, only a small portion, perhaps a single horn of an unexposed pulp, is affected by a localized inflammation. It may not always be possible to differentiate between pulps partially involved and those totally involved in the inflammatory process except by assuming from its intensity and duration that the pain indicates more than a partial pulpitis. This condition represents the dividing line between pulps that may return to normal under the protection of a temporary filling and those that will never return to normal but continue in the line of progressive inflammation to suppurative pulpitis or abscess within the pulp tissue. The usual symptoms are paroxysmal pains lasting only a few minutes, intensified by either extreme of temperature, but more by cold. Usually,

2. Coolidge, E. D.: Treatment of Deep Dental Caries, Proc. 8th Internat. D. Cong., Paris, August, 1931; Illinois D. J., 1:363 (May) 1932.

the pain is of short duration. As reflex pains are not common to this condition, the patient can usually locate the offending tooth. There may be considerable decay, the tooth may be heavily abraded or a deep seated filling or deep

tion is generally very poor except in its earliest stage, which exhibits very mild symptoms, usually recognized as hyperemia.

The treatment indicated is relief of the cause of the disturbance by removal

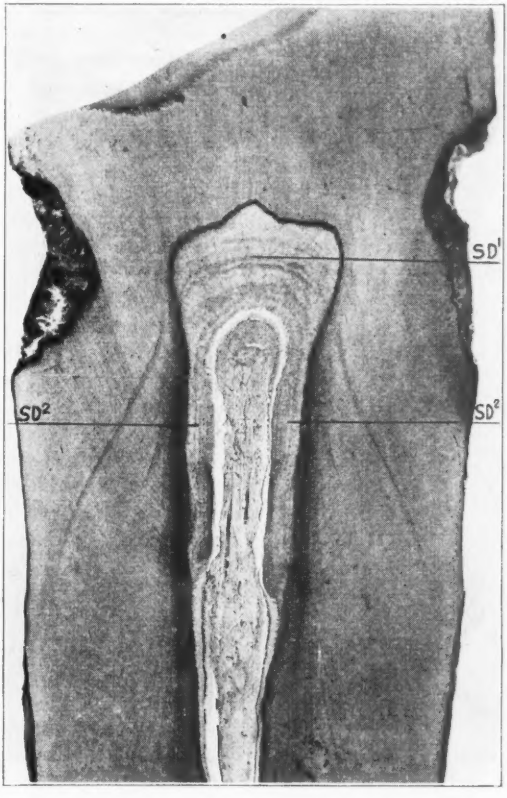

Fig. 3.—Lower central incisor abrasion, mesial and distal caries. SD^1, secondary dentin in coronal third of pulp chamber; response to abrasion. SD^2, later deposit of secondary dentin; response to mesial and distal caries. (Illinois State Dental Journal, May, 1932.)

erosion may exist. It is negative to percussion, transillumination and the roentgen rays, but is more susceptible to the electric current than is the normal pulp.

The prognosis of a pulp in this condi-

of the decay, and application of a sedative antiseptic dressing for a day or two, allowing time for surface disinfection as well as for relief of the congestion of the vessels of the pulp. At a sub-

sequent sitting, the pulp is removed by means of local anesthesia.

ACUTE SUPPURATIVE PULPITIS

Acute suppurative pulpitis is inflammation of the unexposed pulp in which small abscesses are forming in the pulp tissue. The greatly increased number of polymorphonuclear leukocytes and other round cells accumulating in the pulp increase the contents of the pulp cavity beyond its normal capacity and the pressure on the nerve tissue causes intense pain. Occasional small hemorrhages in the capillaries of the pulp and other exudate increase the pressure on the nerve endings. In these centers, breaking down of cells occurs and small abscesses form throughout the pulp tissue.

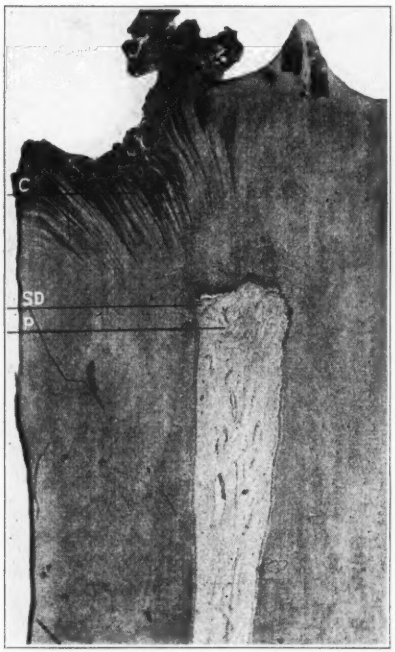

Fig. 4.—Partial pulpitis. *C,* caries of dentin. *SD,* secondary dentin. *P,* inflamed pulp showing enlarged blood vessels and considerable infiltration in coronal portion. The lower pulp is quite normal.

The diagnosis of the condition and location of the offending tooth are sometimes difficult. The pain is violent, throbbing and continuous. It is generally worse on lying down. It is intensified by heat and sometimes relieved by application of ice water. The pain is often reflected to some other tooth on the same side and occasionally to a tooth in the opposite jaw on the same side. It may also be reflected to the region of the ear on the same side. The tooth responds to the electric current, but it requires more than the normal amount to bring response. The roentgen rays are often a distinct aid in the diagnosis, as the periapical soft tissue may appear thickened, showing as a darkened cap over the root apex. Also, a large filling or inlay may be found to lie very close to the pulp cavity; which arouses suspicion regarding the tooth which may or may not be sensitive to percussion. Transillumination sometimes aids in the diagnosis, revealing a cloudy appearance in the crown of the tooth. No swelling of the gum or soft tissue surrounding the tooth is noticeable.

The treatment indicated is always to open the pulp chamber at once to relieve the pressure. A discharge of blood and pus gives immediate relief of pain, after which a dressing of a sedative antiseptic should be sealed on the remaining live pulp for a day or two to allow time for the congestion in the remaining tissue to be relieved before entire pulp removal is undertaken at a subsequent sitting under local anesthesia.

CHRONIC ULCERATIVE PULPITIS

A commonly occurring condition of the pulp is chronic ulcerative pulpitis.

It is a chronic inflammation of the exposed pulp, differing from the acute conditions because the pulp is exposed and does not exhibit painful symptoms unless disturbed by pressure of food or instruments. It presents a necrotic ulcerating surface under which granulation tissue and calcific deposits are commonly found. The constant irritation of exposure to the mouth fluids, foods and disturbed or when the opening to the surface is closed for a time that acute or painful symptoms occur. The condition is found in hidden or neglected places where dental caries has been allowed to expose the pulp by slow progressive development. It is frequently found in teeth having hidden cavities beneath large inlays or crowns. There is no swelling in the periapical tissue, but

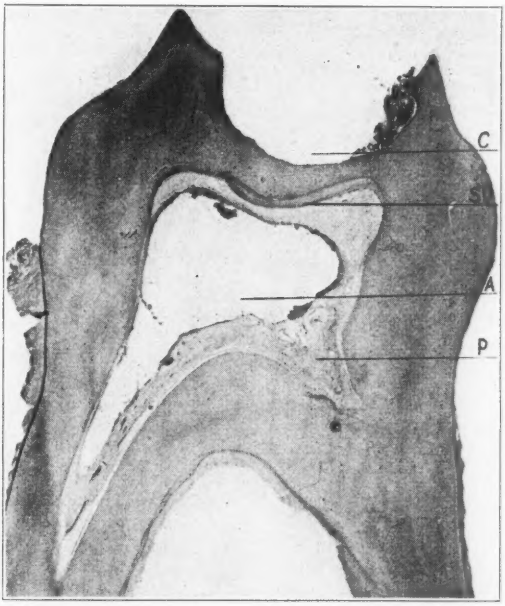

Fig. 5.—Acute suppurative pulpitis of unexposed pulp. *C*, large cavity in dentin which carried a metal filling. *SD*, secondary dentin; an early response to damage to dentin. *A*, pulp abscess. *P*, degenerating pulp tissue.

thermal change is resisted by a persistent but greatly lowered pulp function, and, without severe painful symptoms, calcific matter in numerous small or large nodules is formed in the pulp chamber in an attempt of the living cells to protect themselves from the necrotic superficial tissue. It is only when the pulp is usually the roentgenogram reveals a definite pathologic area in the periapical tissue. Bone resorption has enlarged the periapical space owing to the chronic inflammatory process extending from the pulp to the periapical region. These areas should not be confused with similarly appearing areas found in the peri-

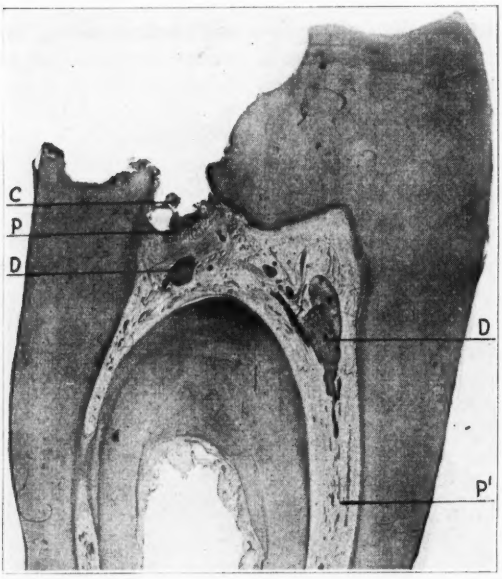

Fig. 6.—Chronic ulcerative pulpitis of long exposed pulp. *C*, caries of dentin exposing pulp. *P*, necrotic pulp on exposed surface. *D*, denticle. P^1, vital pulp tissue slightly inflamed.

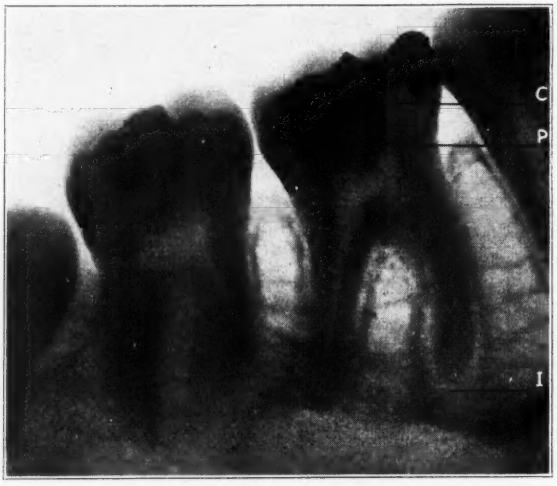

Fig. 7.—Roentgenogram of ulcerative pulpitis in mouth of a 15-year-old girl. There were no painful symptoms except on use of the explorer. *C*, caries of the dentin beneath approximal inlay. *P*, pulp exposed by caries. *I*, large translucent inflammatory area about apex of mesial root.

apical region of pulpless teeth, which may be infected by micro-organisms.

The treatment indicated for this condition is as in partial pulpitis. A sedative antiseptic is sealed on the pulp for a day or two for surface disinfection, after which the pulp should be removed under local anesthesia.

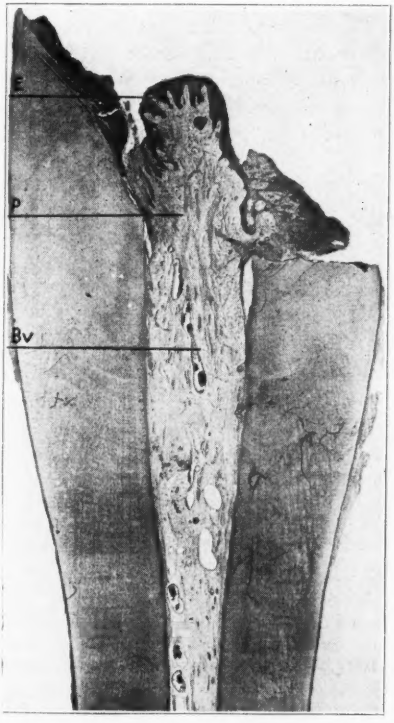

Fig. 8.—Hyperplastic pulpitis (often called hypertrophy). *P*, inflamed and enlarged pulp growing out from pulp chamber. *E*, epithelium covering surface of pulp. Some examples of this type of pulpitis are not covered by epithelium. *Bv*, enlarged blood vessels in degenerating pulp tissue. (After Boulger.)

CHRONIC HYPERPLASTIC PULPITIS

Chronic hyperplastic pulpitis is a chronic inflammatory condition of the exposed pulp frequently referred to as hypertrophy, which slowly but continually spreads by the formation of granulation tissue. This growth is a pulp polypus that protrudes into the cavity, often completely filling it, being flush with the surface of the crown or even protruding beyond. It exhibits only slight sensation on touch, but, when it is wounded, there is a profuse hemorrhage. It frequently becomes covered on its surface with epithelium and is with difficulty differentiated from the gum tissue. It is not a common condition, but is frequently found in the mouths of children whose teeth have been badly neglected. It is an evidence of the strongly defensive reaction of the pulp in children's teeth to external influence.

Hyperplastic pulpitis is not difficult to diagnose, but it may be confused with hypertrophy of the gum tissue, extending into a cavity or growing through a break in the floor of the pulp chamber at the bifurcation of the roots of a molar tooth. Usually, a flat instrument can be used to press the tissue to one side to reveal its source.

The treatment, when the tooth is worthy of saving, is surgical removal of the polypus after cauterizing it with phenol or injecting a local anesthetic. Profuse hemorrhage will follow, after which the blood should be washed away with a normal saline solution. The hemorrhage is a means of depleting the engorged vessels and is beneficial. A dressing of phenol sealed on the remaining tissue for a day or two is usually all that is necessary to desensitize the remaining shreds of tissue so that they may be removed and the canals cleaned at the next sitting. Frequently, a satisfactory result is accomplished by sealing the phenol on the polypus without surgically removing it at the first sitting.

TREATMENT OF CANALS AFTER PULP RENEWAL

In all the foregoing cases, it has been pointed out that the pulp should never be removed at the first sitting. It is a safer procedure regularly to seal a sedative antiseptic on the exposed pulp before removal. This practice is for two purposes: (1) to disinfect the surface of the pulp where a large percentage of the micro-organisms are lying, before they are carried into the deeper tissue in the pulp chamber and canals, and (2) to relieve both pain and congestion. A better operation is possible if vascular congestion is relieved before the tissue is disturbed. Not only is the tissue in the canals improved by the treatment, but the surrounding periapical tissue is benefited as well.

After administration of local anesthesia, the pulp chamber is opened widely to afford adequate room for entering the canals easily. The pulp in large canals is easily removed at once with barbed broaches and the surface of the canal is filed smooth to remove all tissue shreds and clinging odontoblasts. The small canals are entered with the finest files, size xxx, and filed for their entire length. Consecutive sizes of the same files are used one after the other, filing the entire length of the canal, and at the same time raking out the pulp and débris with each back stroke. After careful and continuous filing with files of graded sizes, barbed broaches may be used for raking out the débris, until the canals are clean and smooth and accessible for filling. In all cases, it is advisable to insert a measurement wire in each canal and take a roentgenogram to determine whether the canals are open sufficiently and as a guide to the length of the canal in filling. Attempts to fill small canals before they are sufficiently enlarged to accommodate a root-canal plugger and guttapercha cones only invite failure.

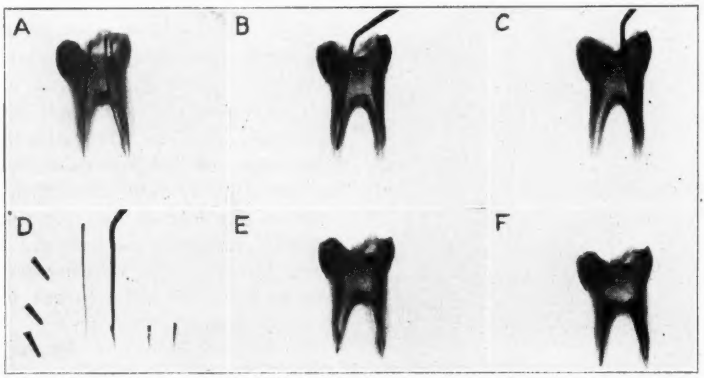

Fig. 9.—*A*, canals opened to their foramina. Measurement wires extending from a level of the mesioclusal cusp into each canal. *B* and *C*, canals enlarged to receive a No. 34 (S.S.W.) or No. 1 (Kerr) root-canal plugger. When the plugger is inserted to the bend, it reaches to within 2 mm. of the foramen. *D*, guttapercha points cut for packing. The first piece selected to seal the apical foramen stuck to the plugger. *E*, first pieces inserted and packed in apex of canals. *F*, canals filled. (Technic of William A. Gilruth.)

It is always advisable to place a mild antiseptic dressing in the canals and seal the tooth until a subsequent time for filling. For this purpose, oil of cloves or cresatin has been found very satisfactory. The less the drug injures the irritated periapical tissue, the better. Nevertheless, it is better to take this precaution, since micro-organisms may have been carried into the canal during the operation. In the removal of the pulp, the tissue is severed as close to the apical foramen as possible, a wounded surface being left close to the periapical tissues. A reactive inflammation follows, and any additional irritation of a chemic nature due to the drug used as a dressing increases the burden in the healing process. Healing of the wounded surface is to be desired rather than any further destruction of tissue beyond the reach of cleaning instruments. The healing process so well described by Blayney[3] should be the goal toward which the operator strives in the treatment and filling of root canals. Keeping in mind the anatomy of the root canal,[4] the size of its foramen[5] and the frequent inaccessible collateral branches in which remaining shreds of living tissue must be left behind, the operator should strive to retain as high a degree of vitality and function as possible in the pulp stump and its ramifications[6] after the canal is filled. Under these conditions, remaining soft tissue within the root becomes changed in character and replaced with hard tissue, which often obliterates accessory canals and greatly reduces the size of the foramina. (Fig. 15.) With the natural forces cooperating with our efforts, we may be confident of the successful outcome of the treatment.

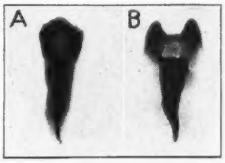

Fig. 10.—*A*, upper second bicuspid canal filled and film exposed in usual buccolingual direction. *B*, film exposed in mesiodistal direction, showing broad flat canal with filling well condensed and spread to entirely fill all space. Single cones unpacked would scarcely fill such a canal completely. (Technic of William A. Gilruth.)

There is some controversy over the question of the presence of micro-organisms at the apices of filled roots that are negative to the roentgen ray.[7] It is not logical to say that because disinfectant properties are soon lost when materials are sealed in root canals, root-canal filling is doomed to failure. Any infected wound that heals does so by overcoming the organisms. Dr. Gardner admits the possibility of overcoming the organisms by medication. If the canal is filled and the foramen closed, healing in the periapical tissue follows. He claims that it is possible for a live pulp to throw off streptococci as do other parts of the body. On the same basis, he should admit the greater possibility of a healthy

3. Blayney, J. R.: Present Conception of Vital Reactions which Occur Within Apical Tissues After Pulp Removal, J. A. D. A., 16:851 (May) 1929.

4. Hess, Walter, and Zurcher, Ernst: Anatomy of Root Canals, New York: William Wood and Company, 1925.

5. Coolidge, E. D.: Anatomy of Root Apex in Relation to Treatment Problems, J. A. D. A., 16:145-6 (Aug.) 1929; Reaction of Cementum in Presence of Injury and Infection, ibid., 18:499 (March) 1931.

6. Footnote 5, second reference.

7. Gardner, B. S.: Dental Infection as Etiologic Factor in Certain Diseases, Bull. Chicago D. Soc., 12:14 (Dec. 17) 1931.

periodontium's throwing off streptococci when the root canal has been properly treated and filled.

NECROSIS AND GANGRENE, PUTREFACTION OF THE PULP

Necrosis, a term applied to dead tissue, may occur in several forms. Coagulation is produced by heat or coagulating drugs. Liquefaction necrosis is a disproteolytic enzymes and putrefactive organisms take part. When there is no moisture present, a form of dry gangrene occurs in which putrefactive changes cease, while, in the presence of moisture, continuous putrefactive changes take place in protein material, with the accompanying byproducts such as gases and poisonous amins.

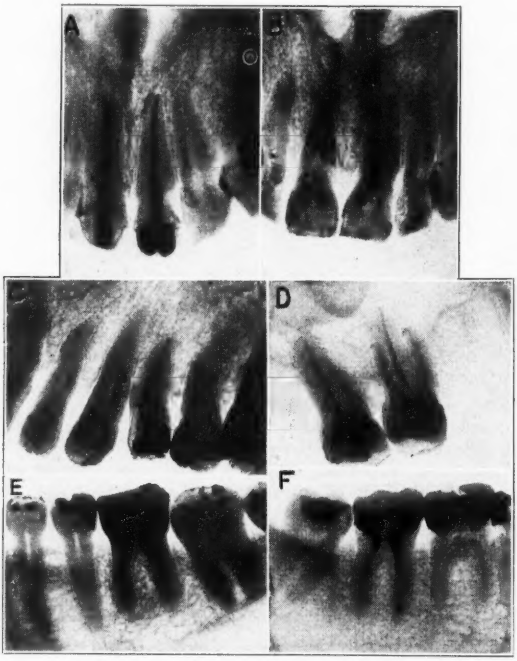

Fig. 11.—*A*, root canals filled after pulp removal two years previously. Fracture of the central incisors of a girl, aged 13, necessitated pulp removal and canal filling. *B*, root-canal filling of two years' standing in a woman, aged 35. The canal was filled after pulp removal five years earlier. *C*, recent canal filling. *D*, *E*, *F*, examples of canal fillings of many years' standing. The periapical tissues are in good condition.

solution as by an enzyme producing a sterile abscess. Caseation is emulsification to a cheesy consistency sometimes observed in pulp decomposition. Gangrene is a form of necrosis in which both

An unexposed pulp may die from shock, trauma or the presence of deep fillings or toxic drugs, and later become infected. The same putrefactive changes may occur from the subsequent infec-

tion of such tissue, as when a pulp becomes infected through the approach of dental caries, which eventually causes its death. Putrefactive changes in the pulp concern the operator mostly because of the presence of pus-forming organisms, which proliferate rapidly in dead tissue and penetrate into all parts of the tissue proliferation occurs from the irritation of micro-organisms and their poisonous products. Putrefactive changes in protein material which produce foul odors are one of the principal characteristics of the conditions. These odors are chiefly attributed to the formation of putrescin and cadaverin from the amino-

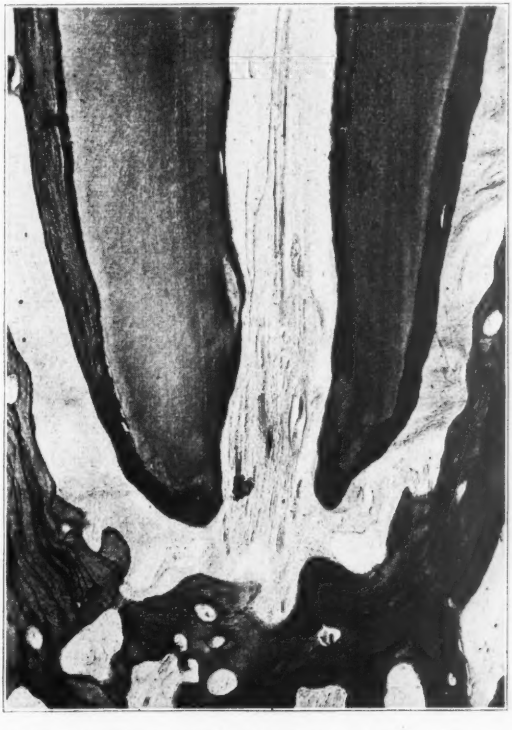

Fig. 12.—Anatomy of root apex, canal and periapical tissue. There is no constriction in the apical portion of this canal.

contents of the root canal. Exposure to the air and free drainage of the putrefying pulp would, in most cases, eliminate painful symptoms; but, without free drainage, the byproducts of bacterial action enter the periapical tissue and painful symptoms or inflammatory acids arginin and lysin of protein splitting.

Pulp gangrene is first indicated by a lack of response to the usual vitality tests of the pulp. The absence of symptoms leads to suspicion that the pulp is nonvital and frequently the roentgen-

ogram reveals a very deep filling or some periapical disturbance. If an unexposed gangrenous pulp is present, the crown usually is darkened and shows a dark shadow in transillumination. The patient is unconscious of the existence of the condition until, on exposure, he becomes aware of the disagreeable taste and odor. Not until the periapical tissue becomes infected or irritated by the escape of micro-organisms or poisonous putrefactive products is there any evidence of pericementitis. There is a complete lack of sensation to heat and cold, and no response to the electric current, in a totally gangrenous pulp.

Fig. 13.—Widely diverging apical foramen. It would be difficult to seal the apical foramen with filling material.

PROGNOSIS

The possibility of saving the tooth whose pulp has undergone putrefaction depends on control of the infection, mechanical cleansing of the canal and disinfection of the dentin and inaccessible canals, followed by a complete closing of the apical foramen and canal with a stable filling material. Clinical records substantiated with subsequent examinations by roentgenograms give evidence

of a high degree of success. The problem is more complicated and the tooth has a more unfavorable prognosis than the tooth whose inaccessible canals contain living tissue, as can be readily appreciated on microscopic examination after root-canal filling. On frequent roentgenographic examination, a large percentage of these teeth show no evidence of periapical disease. There is a definite defensive force created locally in the tissues while the pulp infection and eventual pulp gangrene and putrefaction have been developing. When to this defensive force is added the assistance of proper treatment to destroy the micro-organisms together with mechanical cleaning and sealing the opening to the tissues by means of a stable and non-irritating filling material, the disturbing elements are removed. The significance of the presence of this root in its socket is little different from that of the one from which a living pulp has been removed. There is a very hopeful prognosis for the tooth. It must of necessity

Fig. 14.—Apical foramen on side of root. A filling in such a canal would not be found to reach the apex of the root when roentgenographed.

present a more difficult problem, but the same vital force surrounds the root in case of either pulp vitality or pulp gangrene, and the duty of the operator is to control intelligently either condition without lowering the vital reaction of the tissue surrounding the root apex. The most that can be done by treatment of any kind is to assist the natural forces in the control of local conditions.

The presence of pyogenic and pathogenic organisms in a gangrenous pulp is of the greatest significance in treatment of the condition. These organisms are responsible for the decomposition of the protein molecule into its putrefactive products with the complication of gas formation. It is the toxin and endotoxin poisons from the bacteria that are largely responsible for the chronic inflammatory disturbances in the periapical tissue and, most important of all, it is the organisms themselves that produce septic pericementitis and acute alveolar abscess

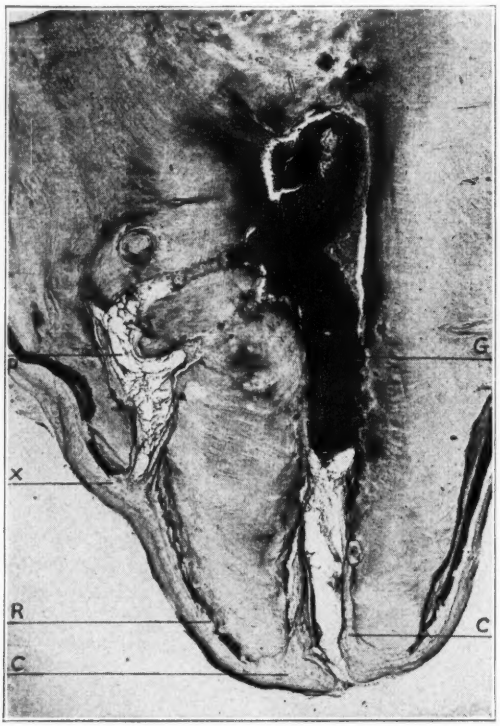

Fig. 15.—Cementum reaction six months after pulp removal; apex of buccal root of upper molar. *G*, guttapercha filling main canal nearly to apical foramen. *P*, collateral branches of root canal. *R*, resorption in cementum and dentin covered by new layers of cementum *(C)* creeping upward into canals.

when forced through the apical foramen. Therefore, the principal factor in the treatment is control of the infection and, as a result, cessation of both the putrefactive changes and the formation of gaseous and other by-products that play only a secondary rôle in the process.

TREATMENT

Treatment of a tooth whose pulp has become gangrenous or has undergone putrefactive changes consists in (1) controlling the infection, (2) cleaning the canal, (3) disinfecting the accessory canals and the dentinal tubules as far as it is possible, (4) stimulating the periapical tissue to activity when pathologic and (5) sealing the foramen and thoroughly filling the canal.

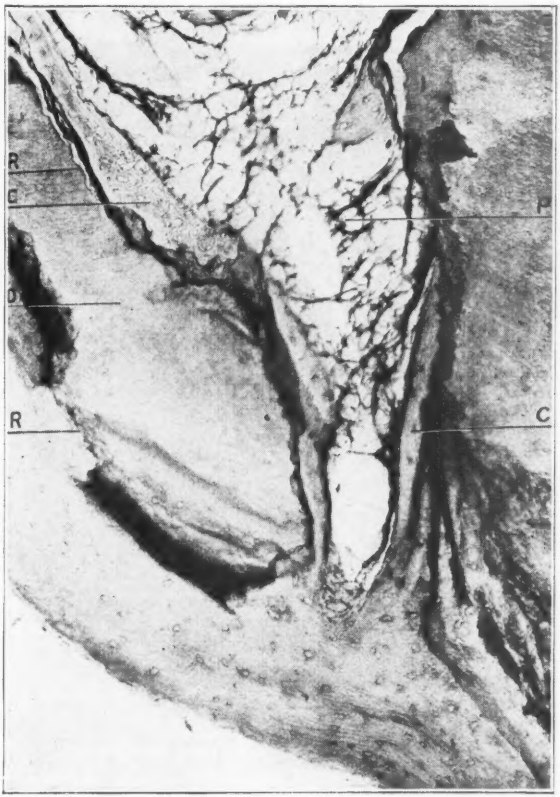

Fig. 16.—Higher magnification of area *X*, Figure 15. *D*, dentin. *C*, deposits of cementum replacing atrophic pulp tissue *(P)*. *R*, rough border of dentin where resorption preceded deposit of cementum.

The organisms of greatest virulence are the streptococci of both the viridans and hemolytic type, together with pus-forming staphylococci and rods.

In the control of the infection, the use of chlorin solutions which became a standard treatment for infected wounds in the late war is especially indicated in treating infected root canals because these are powerful and penetrating germicides that do not cause much injury to living tissue. There are several forms in which the chlorin preparations can be used.

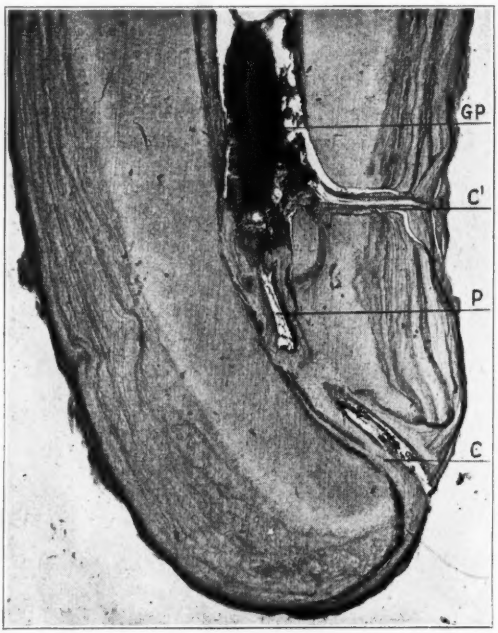

Fig. 17.—Apex of root nearly filled with guttapercha for fifteen years, showing how repair cementum reduced size of canal at apical third by invagination of cementum along walls of canal. *GP,* guttapercha filling. *C,* cementum built along wall. *C,* cementum filling lateral branch. *P,* atrophic remains of pulp.

Dichloramin T dissolved in a solution of chlorinated paraffin oil to make a 5 per cent solution gives very satisfactory results. This crystalline substance is practically insoluble in water, but, when dissolved in paraffin oil, has the property of yielding nascent chlorin slowly. It contains 29 per cent available chlorin. It is best prepared in a small quantity as it will not keep more than from four to six weeks at a time, even in a dark bottle. It can be made by placing 3 grains of dichloramin T in a clean, dry test tube or bottle, then adding 2 or 3 drops of chloroform and, after a little agitation, 1 dram of chlorinated paraffin. This should be warmed gently for a few minutes, until a clear solution is formed. It must not be heated rapidly nor so high as the boiling point of water as it decomposes easily. A clear solution is absolutely essential for successful treatment.

A second preparation, somewhat simpler to prepare and which, from

clinical experience, has proved to be just as satisfactory, is the water-soluble chloramin T. This powder in pure form may be used to make a solution that is somewhat more stable than the former. The following formula has been used for several years with complete satisfaction.

Chloramin T (U. S. P.).....5 gm.
Sodium chlorid .....0.8 gm.
Sodium hydroxid .....0.5 gm.
Distilled water q. s. ad.....100 c.c.

The solution should be kept in a dark bottle away from the light. In order to keep a clear solution, it is necessary to renew the solution at least every two months. It contains 15 per cent available chlorin and yields it more rapidly than dichloramin.

Another method of obtaining nascent chlorin for treating root canals is the ionization of a 1 per cent sodium chlorid solution by means of the electric current. Prinz, Appleton, Johnston, Sharp and others who practice electrolytic medication report very good results from the use of this method. Many of our European colleagues have followed the recommendation of Walkoff[8] in using monochlorphenol with an equal part of camphor. This is a preparation of phenol in which one hydrogen atom is replaced by chlorin. The substance is a strong, penetrating germicide that slowly yields chlorin. When crystals of monochlorphenol and an equal amount of camphor are placed together in a dry bottle, they

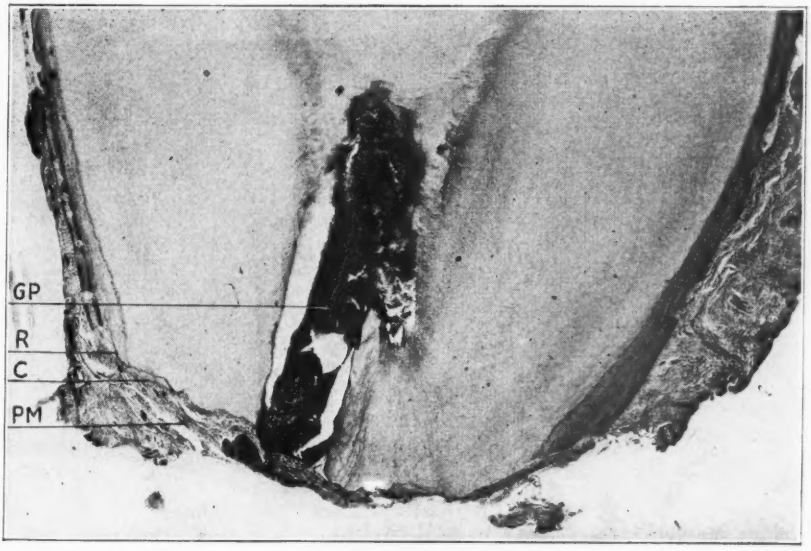

Fig. 18.—Apical portion of root treated for chronic infection and canal filled with guttapercha. *GP*, guttapercha canal filling. *R*, resorption of root surface and evidences of repair under way at *C*. *PM*, periodontal membrane showing no evidence of inflammation.

8. Walkoff, Otto: Mein System der Medicamentösen Behandlung schwerer Erkrankungen der Zahnpulpa und des Periodontiums, Berlin: Hermann Meusser, 1928.

soon form a stable liquid. This liquid is given the credit of being "one of the most serviceable therapeutic agents for the treatment of infected root canals.[9]"

Chlorin solutions should be used in a different manner from that generally used in applying other gemicides. The rules for germicidal action as outlined by Prinz are that (1) a germicide must have sufficient strength to destroy the micro-organisms; (2) it must have time enough to destroy the organisms in the surrounding medium, and (3) it must have direct contact with the organisms in order to destroy them.

A solution of chloramin T or dichloramin T of a 5 per cent strength will destroy all micro-organisms found in a gangrenous or putrefying pulp. The exudates present in the root canal will dilute the germicide, but it is still germicidal when diluted far below 5 per cent strength. Chlorin is rapid in its action, attaching itself to the protein molecule or organisms or organic matter. It is quickly exhausted in the presence of continuous exudate. Washing the cavity and pulp chamber with the solution is a very important factor while the operation is in progress. This affords contact of the germicide and micro-organisms and, owing to its rapid chlorination of septic matter, it frees the pulp chamber

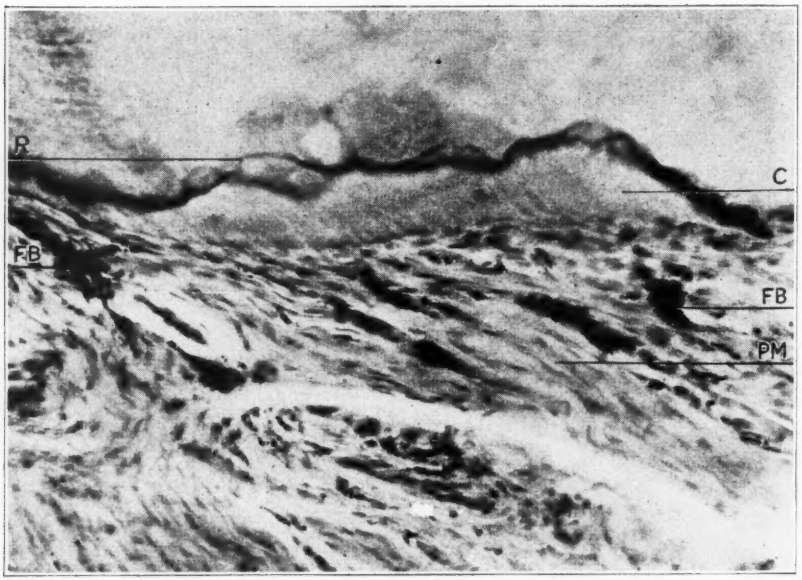

Fig. 19.—Higher magnification of area *C*, Figure 18, showing cementum repair *(C)* on dentin of root *(R)*. *PM*, periodontal membrane showing no inflammation. *FB*, small foreign bodies, probably particles of chloropercha "healed in" in periodontal membrane without reaction.

9. Prinz, Hermann: Diseases of Soft Structures of Teeth and Their Treatment, Philadelphia: Lea & Febiger, 1928.

contents of much of its infectious material while it is being cleaned and penetrates into accessory canals. The mechanical process of cleaning is greatly facilitated by this chlorin wash, and there remains less for the treatment to accomplish when the cavity is dressed and sealed with the same drug for a period of from twenty-four to forty-eight hours.

At a second sitting, the canal may be safely cleaned and washed to the foramen with the chlorin solution, after which an absorbent point saturated with the solution is placed well up in the canal and allowed to remain another twenty-four to forty-eight hours. It is sometimes necessary to repeat this step another time to destroy the odor and assure sterility. Frequently, when a large foramen is found, a considerable exudate follows the treatment with a chlorin solution. Chlorin is a lymphagogue, and if some exudate is brought out, it will

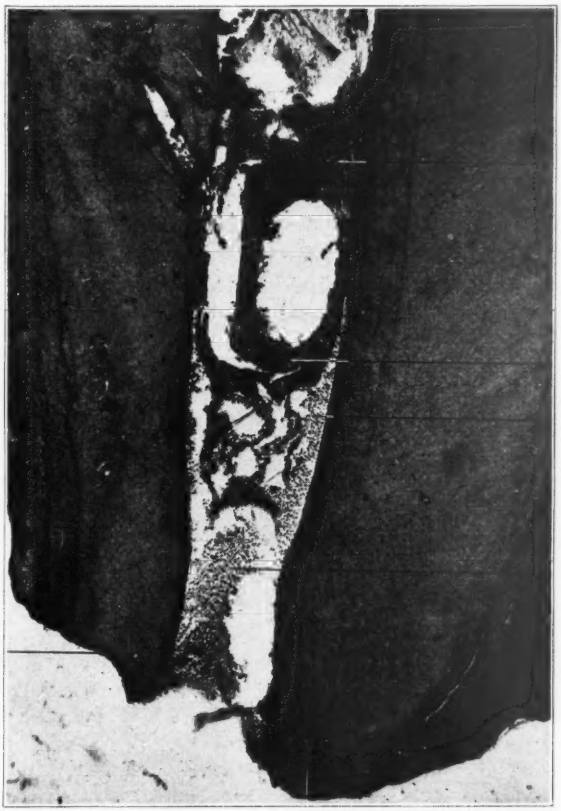

Fig. 20.—Infection in root canal with, consequently, no bone deposit. *A*, guttapercha root-canal filling partly lost in sectioning. *B*, leukocytes (pus); *C*, resorption at apex.

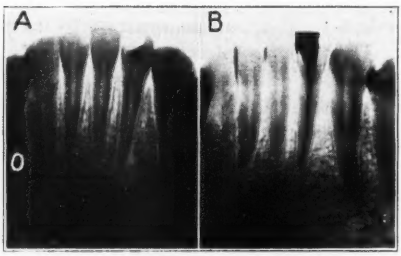

Fig. 21.—*A*, lower right lateral incisor of girl, aged 17. The pulp died after an accidental fracture. Rarifying osteitis is seen at *O*. *B*, normally appearing periapical area after root-canal filling. There was evidence of satisfactory healing two years later.

usually be found on culturing to be sterile. The draining of this exudate from the altered periapical tissue is beneficial to the healing process in the periapical region. When an exudate appears, a dry absorbent cone can be sealed in the canal for from twenty-four to forty-eight hours, after which the canal will usually be found dry and ready to be filled. After from two to four treatments, the infection should be entirely controlled, but it is a good procedure to follow the chlorin with a mild antiseptic such as Lugol's (iodin) solution, cresatin or cresol, which may be left in the canal for several days to allow healing to progress before filling the canal.

The mechanical washing of the canal with the chlorin solution and the mechanical process of cleaning and enlarging the canal are both important factors in freeing the canal of infectious material. The canal should be entirely prepared for filling and a final dressing of the antiseptic sealed in it for a few days before filling. By this practice, there is more assurance of complete surface sterility, since the dentinal tubules may sometimes harbor micro-organisms beyond the reach of germicides. If the canal is thoroughly filled immediately after the antiseptic treatment without the opening up of additional surface where germicides have not had contact, the root is well protected from reinfection at a later period. It will be found by a careful routine checking of root

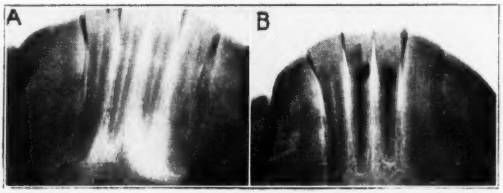

Fig. 22.—Lower incisors with large cystlike area in a man, aged 25. Repair after five years is shown in *B*. There was no surgical treatment in the cases shown in Figures 21 and 22.

canals that have been treated and filled according to this rule that a very high percentage of successful results is obtained. Many pulpless teeth may be saved to give valuable service to our patients. Periodic roentgenographic examinations of every patient are as important as periodic clinical examinations for dental caries. The prognosis in the case of pulpless tooth or one containing a putrefying pulp, when it is properly treated and completely filled to its apical foramen, is very favorable.

It is more important that the filling completely fill the canal of this type than when living tissue remains in the apical

portion of the root canal. The presence of living tissue in the apical third of a canal invites the biologic forces to a reconstruction of pulp remnants into hard tissue, but open spaces in a filled canal without living tissue invite exudates, which soon become stagnant fluids and form pus. Microscopic evidence of new cementum formation and the development of healthy connective tissue on the apices of carefully treated pulpless roots has been shown by several investigators. Such evidence, together with the large amount of clinical evidence available, should offer sufficient proof of the possibilities of saving this class of teeth.

MOTTLED ENAMEL

By J. J. REED, D.D.S., Beloit, Wis.

IN the study of the etiology of mottled enamel, the findings to date are that there are two factors: (1) a susceptibility to injury of the living protoplasm of the cement substance of the enamel and (2) injury to this susceptible cementing substance, which, according to G. V. Black, causes its destruction and disappearance. It has been proved that the susceptibility is caused by an excess fluorin content in the water supply and evidence is strongly in favor of the action of the actinic rays of the sunlight as the cause of the destruction of the cement substance or the injury.

There can be a susceptibility which may not involve injury, as in the case of the lower incisors, but we cannot have destruction of the cement substance without the actinic injury. Fully developed enamel is immune. Enamel grown in an area in which mottling is endemic is susceptible, but only those teeth are affected that have been exposed to the sunlight.

The cause of the injury has been an elusive factor. It has been spoken of recently as the "unknown factor."

A brief review of the literature on mottled enamel, showing what has been done, will help us to better understand the subject.

THE LITERATURE

In the published results of the study of mottled enamel by G. V. Black, we read:

> The most essential injury to the teeth is the appearance. The teeth are of normal form but not of normal color. They may be stained brown or yellow or an opaque white. The injury is distinguished especially by the destruction and absence of the cement substance between the enamel rods in the outer one-fourth (more or less) of the thickness of the enamel. The outer glazed enamel or Nasmyth's membrane is present and appears normal. A sharp explorer slides over the surface without catching just the same as it would over normal enamel. The brown stain cannot occur unless the enamel has the mottled defect or injury.
>
> The districts where this defect occurs are found in Colorado, Texas, Virginia, Arizona, South Dakota, Minnesota and in other parts of the world as China, Spain, Mexico, Italy, Holland and other countries. Wherever it is found the essential characteristics of mottled enamel are the same. This defect in mottled enamel is an acquired defect and must not be confused with those deformities which occur during the growth of the enamel, such as those caused by fever and

arrest of growth of the enamel accompanying such child diseases as measles or scarlet fever in which the enamel is banded or pitted. Mottled enamel is very frequently coincident with freckles.

The University of Arizona reports "definite proof" that mottled enamel is caused by an excess of fluorin in the water supply. They found that, in localities where the water has one half part fluorin per million parts of water, there is immunity to mottling; whereas, water of four parts fluorin per million parts gives a high rate of mottled enamel cases, as much as 85 per cent. Artesian wells have been found with a fluorin content of twelve to fifteen parts per million. The fluorin causes a susceptibility which varies according to the amount of fluorin in the water supply.

Dr. McKay writes: "Mottled enamel as a rule is limited to the upper front teeth, is rarely on the lowers and practically none on the lingual surfaces. Deep artesian wells seem mostly responsible for mottled enamel but not entirely." Dr. McKay thinks there is another factor besides the artesian water.

Dr. Beust said, "The lesion is not developmental, it is the result of trauma . . . the mottling follows the lip line and is mostly on the centrals, less on the laterals and just on the tips of the cuspids. The lower teeth are rarely stained although formed at the same time as the upper teeth and should be just as susceptible."

There seems to have been some controversy as to whether the white spots were on the tooth before it appeared through the gum or they developed after the tooth erupted. Dr. Arthur wished to make this point clear. He said, "The white spots appear as soon as the tooth is fairly through the gum and continue to appear during the eruption of the tooth. . . . Let me say right here that the white spots are *not* beneath the free margin of the gums." The temporary teeth are never mottled. On teeth the enamel of which does become mottled, the white spots are small at first, enlarging until they coalesce and the enamel becomes a uniform white.

SUSCEPTIBILITY

Outside the susceptible area, the enamel is immune. The fluorin in the water supply in these areas of susceptibility has some influence on the growing enamel which causes it to become susceptible to the destructive action of the actinic rays. Dr. McKay thinks this is an "inhibiting" or retarding effect which would keep the enamel immature or susceptible to the injury. Even in normal enamel, at the time of the eruption of the tooth, the cement substance has not completed its work of calcification of the enamel. The fluorin retards growth of the enamel, in areas to which mottling is endemic, making it susceptible to injury from the actinic rays.

About three years after the tooth appears through the gum, the root is fully formed. It would seem, at this period in the life of the tooth, that the cement substance is not in an advanced state of calcification. J. Leon Williams writes that "nutritive metabolic changes occur in enamel after the eruption of the tooth."

Dr. Bödecker says: "The cement substance of the enamel is analogous to the cement substance of the epithelial tissue; as seen in sections it gives off exceeding fine thorns which apparently pierce the prisms at right angles to their length and form a close network which renders the enamel much more active than it is considered to be."

Sudduth says: "There are various reasons to suspect that enamel is not out

of the pale of nutrition when a tooth erupts. In the developing tooth the cement substance is larger in amount than in the fully formed organ." This shows that the cement substance is alive and immature when the tooth erupts. Dr. McKay speaks of the artesian water as having an effect of "inhibiting the growth of the enamel." The cement substance, not being mature, is destroyed by an action of the actinic rays similar to a sunburn of the skin, which, in some cases, causes death of the cells in the deeper layers of the epidermis. The cement substance must be living and susceptible to be destroyed, and it is destroyed and therefore was susceptible.

THE ACTINIC RAYS

The enamel and the epidermis of the skin are closely related. We read in embryology that from the epiblastic layer are formed the epidermis of the skin and all its appendages, such as the hair, nails and enamel of the teeth. (Cryer.) The enamel has pigment, but the dentin is white. The color of the skin depends on the deposit of pigment granules which are formed in the lowest stratum of cells in the epidermis. The epidermis is nonvascular, but has a nerve supply, as we read that "from the most superficial plexus of the skin situated immediately below the epidermis, fine nonmedullated nerve fibers pass upward between the cylindrical cells of the stratum Malpighii of the cuticle, where they terminate."

The destructive results of the action of the actinic rays on the enamel and on the epidermis of the skin would be about the same, except that the destruction of the tissue of the epidermis can be repaired, but destruction of the enamel tissue cannot be repaired. We will first notice the action of the actinic rays in sunburn, which is termed erythema. This is caused by the actinic rays which are in the violet and ultraviolet portion of the spectrum. Dr. Russel, of England, says:

> Erythema from sunlight most often occurs in the spring time when the previous summer's pigment has disappeared. Actinic erythema appears only after a latent period of from four to twelve hours. This latent period is very variable. The erythema produced by ultra light radiation also differs from other inflammations in that it is nearly always followed by pigmentation, such as tan or freckles. The erythema varies in severity according to the length of exposure and the sensitiveness of the patient, from a faint reddening to a necrosis of the epidermis or death of the tissue.
>
> The maximum vital response takes place in the cells of the basal layer of the retromucosum. This important layer of cells has for its function the reproduction of destroyed skin and the formation of pigment. Microscopic examination of the skin reveals serous swelling of the deeper layers of the epidermis, the cell nuclei of the granular and Malpighian layers being especially affected. Vesicles form and there is a migration of leucocytes into these two layers. Pigmentation can occur only if there has been a preceding erythema. The phenomenon is due to the deposition of the pigment melanin, as granules around the nuclei of the basal cells of the epidermis. These granules form a screen round the nuclei and protect them from an overdose of the ultra violet rays and when pigmentation has once taken place, there is less danger of excessive actinic erythema. The degree of the pigmentation has no direct relationship to the intensity of the preceding erythema. The whole range of actinic rays between 3130 Å and 2530 Å, can cause erythema but the maximum effect is produced by rays of 2970 Å, which provoke almost one third of the total erythema.

According to Burge, ultraviolet radiation kills living cells and tissue by changing the protoplasm of the cells in such a way that certain salts can combine with the protoplasm to form an insoluble compound or coagulum.

In the fourth layer of the epidermis,

the stratum mucosum, the cells are polygonal and are connected by delicate prickle-like processes. These are the so-called prickle cells. It is in the deeper layer of these cells that the pigment of the skin is found.

Una, a dermatologist, gives the pathology of freckles as follows: "The prickle cells become softened and finally lose their spinous processes. The pigment granules are distributed both inter and infracellularly with a copious pigmentary deposit. The actinic or chemical rays of the solar spectrum are responsible." Thus, we see the destructive effect of the actinic rays on the tissue cells of the epidermis. This effect may range from a slight redness to a destructive necrosis, or death of the epithelial cells. One authority gave the cause of a freckle as a pigmentation to protect the terminal end of a nerve fiber. Freckles and pigmented areas are found to be entirely nonfluorescent.

The freckle of the skin and the white spots on the enamel may have something in common. The white spots on the enamel are small at first, enlarging until they coalesce and become a uniform white stain. In mottling of enamel, we have a destruction of the cementing substance which corresponds to a necrosis or death of the epithelial cells. It is a coincidence that the temporary teeth do not mottle, and at this age the child does not freckle.

THE INJURY

The research work of the University of Arizona, which was done by Margaret Cammack Smith and Edith M. Lenz, of the Department of Nutrition, and H. V. Smith, of the Department of Agricultural Chemistry, in discovering that fluorin in excessive amounts in the water supply is one of the factors in mottling of enamel, is endorsed by Dr. McKay, who has been in charge of the research work since its beginning and who says, "There is yet an unknown factor in the causation of mottled enamel." Dr. Beust says that this lesion is not developmental but is the result of trauma.

The evidence is convincing that the destructive action of actinic rays is the "unknown factor" of Dr. McKay and the "trauma" of Dr. Beust.

In summing up this evidence, we note, first, that the enamel is not injured until exposed to the sunlight. Dr. Arthur writes that the white spots form as soon as the teeth are fairly through the gums, and continue to appear as the tooth erupts, and that the white spots are *not* under the free margin of the gums. Again, the lower teeth are formed at the same time as the upper teeth, and should be just as susceptible, yet they are rarely injured because they are shielded from exposure to the sunlight by the lower lip.

G. V. Black wondered why the "first molar, which is formed at the same time as the incisors, is so rarely stained." This is because their location farther back in the mouth is not so favorable to direct exposure to the sunlight. Again, in most cases the mottled enamel is found on the surfaces of the teeth where the sunlight can shine directly on them, as noted in the description found in the literature, which says "The mottling follows the lip line and is mostly on the centrals, less on the laterals and just on the tips of the cuspids." And again, why is it that the mottling never crosses the incisal edge to the lingual surface?

In some mouths, the teeth are more likely to be injured than in others; for example, mouths with a short upper lip, mouths with V-shaped arches and

also mouths of mouth breathers. A nice illustration of this came to hand in a letter from Arizona where the average for cloudy days per year is very low. Evidently for this reason, in the regions of susceptibility there, the mottled cases run as high as 100 per cent. The letter reads as follows:

> Mouth breathing was once mentioned as a possible cause of mottled enamel because of the finding of more stain on the mottled teeth of children whose nasal passages were obstructed for one reason or another. We have repeatedly noticed more staining on the teeth of those who had bow shaped mouths or receding lips, which meant that the teeth were exposed a greater part of the time. I recall one adult particularly who had a bow-shaped mouth, was exceedingly jolly and laughed a great deal of the time so that her mouth was open most of the time. Every tooth in her mouth back to the 12 year molars was stained in the mottled areas.

This shows, in a striking manner, how severely the actinic rays can injure the susceptible enamel in a favorable case.

Some investigators assert that mottling of the enamel is caused by the presence of fluorin alone. If the fluorin only is responsible for the mottling, why are not all the surfaces of all the teeth mottled instead of just the areas which are exposed to the sunlight? Again, why is not the enamel injured the full depth instead of just the outer one fourth of the depth of the enamel? The actinic ray has a surface effect only, while the infrared ray has a deep effect.

BROWN STAIN

The brown stain is the result of the injury, which causes destruction and disappearance of the cementing substance. This substance has been retarded in its development. At the time of the injury, it was a living protoplasm and the action of the actinic rays destroyed its life. It disappears, which means that the liquid or fluid part is absorbed, and there is a residue and the space is, according to Black, "filled with air" which shows through the outer enamel as a dull white spot. The residue is mostly protein matter, which is the essential constituent of all living cells and which may be decomposed by putrefactive bacteria. This decomposed matter, together with the pigment pent up inside the enamel, to my mind causes the discoloration, or brown stain, which shows through the thin outer enamel and might be likened to discoloration of a tooth caused by the death and decomposition of the pulp. The destructive results of the injury to the enamel would be in proportion to the amount of susceptibility and the length of time of exposure to the actinic rays.

RESTORATION OF TEETH DURING THE CHILDHOOD PERIOD*

By JOSEPH K. WAMPLER, D.D.S., Pittsburgh, Pa.

THE restoration of teeth during the childhood period is one of the most important phases of dentistry. The majority of dentists, I am convinced, believe in the principle of children's dentistry and recognize its need, and for this reason I shall not discuss the place of children's dentistry in dental practice. Instead, I shall outline a few of the fundamental principles and procedures that can be converted into practical use in our own offices.

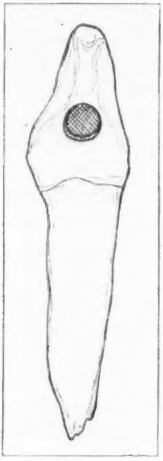

Fig. 1.—Method of preparing cavity on anterior teeth when thick labiolingually.

The average general practitioner has neglected children's dentistry not because of a lack of interest and appreciation, but because of uncertainty as to the proper steps of procedure and lack of experience. The operative procedure on children's teeth is not entirely different from that employed with adults, but the anatomy and morphology of the teeth differ in that special consideration is required in the preparation of the tooth for fillings. This means that the size and structure of the tooth must be given consideration different from that of the teeth of adults.

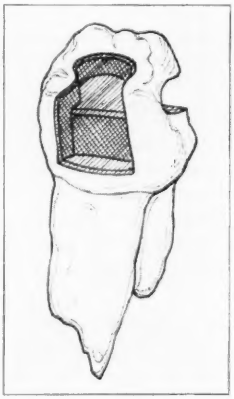

Fig. 2.—Compound cavity preparation on distal aspect of first deciduous molar.

In studying the structure of the teeth, we must consider the porosity of the

* Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Jan. 19, 1932.

dentin and the thinness and brittleness of the enamel that are peculiar to the teeth of children. We must also remember that, comparatively, the pulp of the deciduous tooth is much larger than

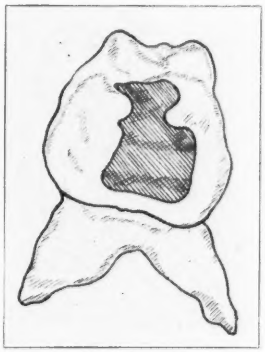

Fig. 3.—Filling with flat contact using copper amalgam.

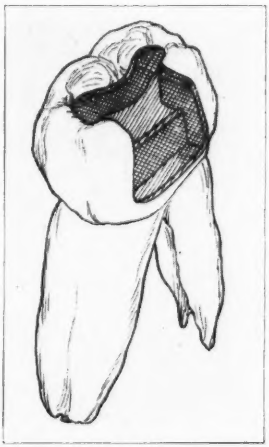

Fig. 4.—Method of extending cavity on lingual surface.

that of an adult tooth, and special care must be taken to prevent death of the pulp by exposure or by the encroachment of a filling.

I have placed copper amalgam at the head of the list of filling materials because it is more commonly indicated in the filling of children's teeth. The advantages of copper amalgam are as

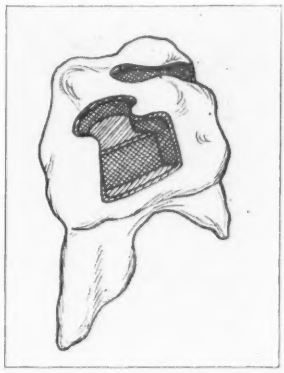

Fig. 5.—Removal of axioclusal angle to allow for greater bulk of filling material.

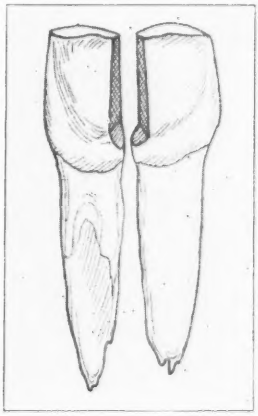

Fig. 6.—Slice preparation and area painted with silver nitrate.

follows: It may be used where thorough dryness cannot be obtained. It will not irritate the gum tissue. It may be inserted quickly and easily and cotton

rolls or napkin removed immediately without waiting for the filling to harden. It may be placed closer to the pulp than any other filling material without causing the death of the pulp. It needs less preparation for retention

Fig. 7.—Cavity preparation on mesial aspect of first deciduous molar without destruction of marginal ridge.

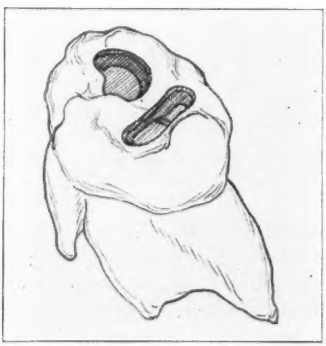

Fig. 8.—Pit and fissure cavities.

than do other materials. It has better edge strength than cements, but not so good as silver amalgam. It has greater crushing strength than most silver amalgams. It protects the margins of the cavity from recurrence of decay because of the germicidal action of the copper salts. The deposition of the copper salts also tends to change the bacterial flora

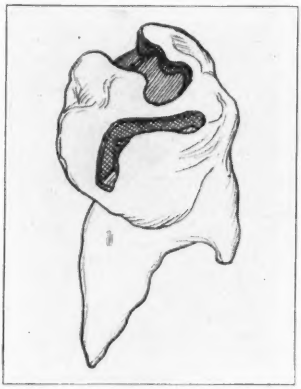

Fig. 9.—Cavity preparation in second deciduous molar beveling cavosurface angle.

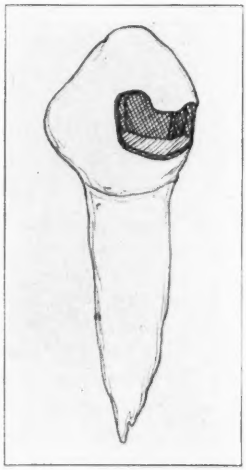

Fig. 10.—Extension of cavity on lingual aspect in thin anterior teeth.

of the entire mouth; which inhibits decay in other teeth.

Some of the disadvantages of copper

amalgam are: slowness of setting, which necessitates caution against the eating of solid foods for at least ten hours; a tendency to cup under the stress of mastication and a darkness, which is an esthetic disadvantage especially on anterior teeth.

The copper amalgam is prepared in the usual way; that is, it is heated in a spoon until beads of mercury begin to appear on the surface, and is then crushed in the mortar and mixed until the mercury has been thoroughly incorporated with the copper. It is then placed in a chamois skin and every possible bit of mercury expressed with a pair of flat-nosed pliers. The dry copper amalgam is then carried to the cavity and packed the same as silver amalgam.

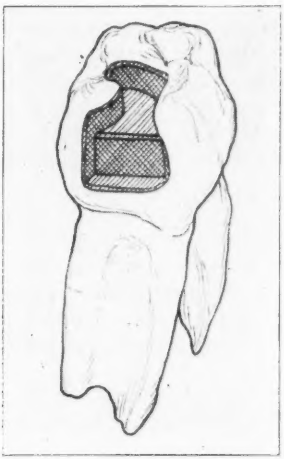

Fig. 11.—Beveling cavosurface angle and axioclusal angle.

It is impossible to establish an ideal contact point with copper amalgam, and many men claim that we cannot use a matrix in filling compound cavities. In my own practice, I have not been able successfully to insert a filling in a compound cavity without the use of a matrix. I first separate the teeth slightly by use of a temporary filling packed in the cavity after its preparation. At the next sitting, I remove the temporary filling, finish the preparation by beveling the cavosurface angle and make a complete toilet of the cavity. The cavity is next thoroughly dried and the matrix placed

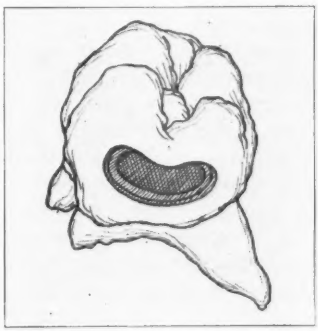

Fig. 13.—Cavity prepared on mesial aspect of second deciduous molar without destruction of marginal ridge.

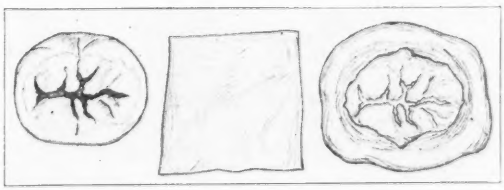

Fig. 12.—Illustration of cavity preparation in first permanent molar and method of filling with synthetic porcelain.

in position. The walls of the cavity are moistened with a creosote preparation instead of phenol. This preparation has a greater germicidal action than phenol and is less escharotic. The cavity is then ready to be filled.

The matrix can be removed immediately without destroying the filling. The teeth will slowly assume their normal positions, thereby establishing a flat contact.

I have found in the mouths of children with excessive acid conditions, in those whose diets show an overconsumption of sweets and in those reaching the age of puberty, whose teeth must be tided over for a few years, that copper amalgam is the only material that can be relied on to protect successfully the margins of the cavity. Cements and synthetic porcelain fillings will invariably have to be replaced every few months; and, in replacing these fillings, we are certain to destroy tooth structure with each operation. The slight staining action of copper amalgam is outweighed by the conservation of tooth structure.

Copper amalgam is also indicated in the deep fissures and partially erupted first permanent molars when they are not in normal occlusion and are therefore not self-cleansing.

Let us next consider the use of cement as a filling material. Cements in restorations made during the childhood period are only temporary at best. Their most important use is as bases; to protect the pulp, or for temporary fillings. Cements will not resist the stress of mastication and will dissolve away from the margins. There is also danger of impairing the life of the pulp by placing cement in too close proximity, owing to the action of the acid in the cement. If used as a filling, this material must be kept under constant observation.

Silicate fillings are indicated in the anterior teeth of children where there are shallow cavities, and are used for esthetic reasons only.

In the restoration of fissures on first permanent molars, where we have deep fissures and little decay, the occlusal surface is first cleaned of all débris, a compound impression is taken of the occlusal surface and the fissures are cleaned out with a No. 00 inverted cone bur extending only to the length and the depth of the fissure. The tooth is now dried thoroughly and packed with a thick mix of silicate, all excess being removed. Over this, a piece of cellophane is placed and the filling is forced to place with the impression compound, which is held in this position until the filling material is set. The use of the impression compound restores the anatomic shape of the occlusal surface and provides proper condensation.

I have found that the combination of a temporary filling and copper amalgam is advantageous in cavities where we wish to protect the pulp from thermal changes and wish to place a fairly durable filling. This filling material is prepared by incorporating a rather thin mix of copper amalgam in a heated mass of temporary filling material. This will withstand the stress of mastication as well as cement and is more easily removed.

Guttapercha is indicated in first permanent molars where, in malformed occlusal surfaces, decay has attacked the deep pits over the entire surface. We prepare the cavities in the usual way, but confine the preparation to the pits and do not include the entire occlusal surface. The guttapercha is first cut in small squares and heated on a tray over a flame, care being observed not to overheat the material, as this will cause it

to become soft and unfit for use. The guttapercha is now carried to the cavity that has been previously dried and the walls moistened with eucalyptol. Cold instruments are used to pack the guttapercha in the cavities. Fillings of this type must be carefully watched because they will not stand the stress of mastication and must be replaced when showing signs of attrition. A patient may be carried through childhood with this type of filling and malleted gold may be later used to replace the guttapercha. Gold inlays are indicated in both permanent and deciduous teeth. In the permanent teeth, they are indicated in cavities on the mesial surfaces of the first permanent molars when the second deciduous molar has been removed and before the eruption of the second bicuspid. Using a filling of this type, we are able to restore the anatomic shape of the tooth and the contact point.

Inlays are indicated in first permanent molars at the age of 10 to 14, when we have to extend the cavity involving the marginal ridge, making a compound cavity. In the preparation of cavities of this type, the operator must be conservative of tooth structure because the roots are not fully developed on molar teeth between 10 and 14 years of age. Instead of going by these rules, the roentgen rays may be used to determine the extent of development both of the roots and of the pulp.

Inlays may be used in the anterior teeth of children from 10 to 12 years of age when a compound cavity involves the incisal angles, and in deciduous molars when the permanent tooth is congenitally missing and we wish to preserve this tooth indefinitely.

It is my opinion that silver amalgam has no place in children's dentistry. As stated under the advantages of copper amalgam, silver amalgam cannot be placed so close to the pulp as copper amalgam without causing pulp death, nor does it have the germicidal properties or the adaptability to the cavity margin, Even the most carefully placed silver amalgam filling will leak at the margins, with subsequent decay and possible death of the pulp, after a period of six months in the mouth of the average child.

I have confined my paper to the principal materials used in the filling of children's teeth and have not touched on some of the broader phases of space retainers, crowns, bridges and prosthetic appliances, which ordinarily fall within the scope of the pedodontist.

SPECIFIC GINGIVITIS

By P. H. BELDING, D.D.S., and L. J. BELDING, M.D., Waucoma, Iowa

GINGIVITIS is a common disease. Conservatively, 75 per cent of the adult population have macroscopically demonstrable lesions and in more than 95 per cent of the cases, *Borrelia vincenti* is found.

This condition is ordinarily defined as any disease process which effects changes in the tissues surrounding the tooth root which have their origin in the gingivae or periodontal membrane.

We may designate those cases specific

in which the spirochete of Vincent can be found and may classify gingivitis as shown in the accompanying outline.

This opinion is based on the finding of *Borrelia vincenti* almost universally in association with gingivitis, its infrequency in children's mouths and in "healthy" adult cavities, its absence in edentulous mouths and the therapeutic response to specific treatment.

The predisposing causes of gingivitis are legion: constitutional debility, acute febrile disease, the use of various drugs, chemical irritation, the use of tobacco or alcohol, poor hygiene, irritative restorations, congenital malformation, malocclusion, partial eruption of teeth, food impaction, the presence of tartar, direct trauma, injudicious use of toothbrush, etc.

Vincent's organisms are spread by direct contact, particularly kissing, and by fomes, especially cigarettes which have come in contact with the saliva: highly efficient means, as is attested by the frequency of this disease in the adult population.

The organism, having gained access to the oral cavity, gravitates to protected areas where mechanically it will not be dislodged and sets up foci from which the mouth cavity is infected. The most common sites are the distal gingival margin of the lower third molars, the buccal margin of the lower incisors and the upper cuspids.

The rapidity and nature of the invasive process are dependent on the resistance encountered, the pathogenicity of that particular strain of organisms and the measures taken to combat it.

- Gingivitis:
  - Specific 95%
    - A
      - Severe
      - Vincent's infection, subacute or chronic
      - Acute
    - B
      - Subacute
      - Moderate, chronic
    - C
      - Mild
      - Chronic
      - Latent
      - Endemic, chronic
      - Unrecognized
      - Incipient
  - Nonspecific 5%
    - D
      - Chemical
      - Thermal
      - Mechanical
      - Bacterial, chronic
      - Anemic, specific organisms generally associated
      - Systemic

The acute and subacute forms, commonly called ulcero-membranous stomatitis or Vincent's infection, are so well understood clinically that most cases are recognized as such and treated accordingly, being insufficiently treated, however, for most cases of acute Vincent's infection of the oral cavity tend toward chronicity.

The mild, latent, incipient endemic form of specific gingivitis constituting more than 90 per cent of all cases has its inception insidiously and is most com-

monly not recognized until well advanced. In the progress of this infection, there is dissolution of continuity of the gingival ligament, edema and retraction of the gums, absorption of the interdental papillae, and bleeding. This process is or eventuates in a condition ordinarily described as gingivitis.

CONCLUSION

The majority of cases of gingivitis are specific. Microscopic studies should be made in all cases of gingivitis. Treatment should be specific if *Borrelia vincenti* is found.

POSSIBILITIES OF ORTHODONTIC TREATMENT*

By FRANK M. CASTO, D.D.S., M.D., Ph.G., Cleveland, Ohio

WITH the accumulation of knowledge in the field of orthodontia, there came a clearer conception of its requirements, and a realization that a better and more thorough training was necessary for those who desired to enter the practice.

As full comprehension of the present status of orthodontia is possible only through familiarity with the events of the past, I shall review in chronological order a few of the important advances made in this field.

In 1728, Pierre Fauchard published a treatise on dentistry in two volumes. This may have marked the beginning of dentistry as a specialty and a profession. One chapter is devoted to the description of orthodontic appliances. Some of the principles enunciated therein are still basic. Fauchard used the labiobuccal expansion arch and formed it into a pattern to indicate the desired alinement of the teeth. This might be conceived as a crude predetermination of arch form.

Between 1728 and 1841, many modifications were suggested in the use of the expansion arch, particularly as related to anchorage. Boudet (1757), Fox (1803) and Delebarre (1819) offered methods of anchorage which they considered to be definite improvements. The most decided improvement was made in 1841 by J. M. Alexis Schange, who used a crib over the posterior teeth and, in addition, employed screw pressure in connection with the arch. He also introduced the clamp band, but placed it on the malposed teeth instead of the anchor teeth.

The expansion arch appliance continued to pass through a series of evolutionary stages, and numerous other types of appliances were invented and recommended to the dentists for use in the correction of malocclusion. Kingsley, Guilford, Farrar, Case and Jackson should be given special mention for their excellent contributions in this connection.

In the last decade of the nineteenth century, E. H. Angle succeeded in perfecting the expansion arch appliance with its component parts, to a point where its

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 19, 1932.

use was made practical and its operation efficient. It is unnecessary to give any further historical date in regard to appliances, since most of us are familiar with their development in the last few years.

A study of the biologic phase of orthodontia ran parallel with the development of mechanical devices. John Hunter, in his book "Natural History of the Teeth," published in the year 1771, devotes three chapters to the correction of irregularities of the teeth. In these, he discusses the causes of malocclusion, and the difficulties encountered in the deciduous and permanent dentition. He also calls attention to the value of ideal occlusion and to the disparity that may exist in the size of the jaws and that of the teeth.

Robert Woofendale, in an article on "Observations on Human Teeth," published in 1783, lays great stress on the removal of the deciduous teeth at the proper time, as a measure to prevent the permanent teeth from assuming malpositions. He also recognized that variations in treatment were necessary in individual cases.

Robert Blake discusses the causes of irregularity of the teeth in his "Inaugural Dissertation," published in the year 1798. He calls attention to the variations in development of the jaws in different individuals at the same age, and criticizes John Hunter for making mathematical deductions and drawing conclusions in regard to development from a study made by the use of dry specimens or skulls of individuals at different ages.

There is to be found much of interest in the writings of Delebarre (1777-1862), who discusses many problems related to diagnosis and treatment.

J. Patterson Clark recognized the importance of maintaining a harmonious relationship of the dental arches. In the year 1863, he wrote: "Irregularity of the mouth is produced by the extraction of teeth from one side of the jaw, while the corresponding ones are permitted to remain in the other."

In the year 1859, Dr. McQuillen offered the following as causes of irregularity of the teeth: (1) hereditary predisposition; (2) bad habits; (3) accidents, and (4) premature extractions.

E. Ware Sylvester, in a paper read before the American Dental Association convention in 1863, says, "We come to the conclusion that a full dental arch and sound teeth are natural according to the designs of the Creator, and that a contracted arch and diseased teeth are the results of a series of violations of natural laws."

Alfred Coleman, in a paper published in the transactions of the Odontological Society of Great Britain, in 1865, discusses the constricted apical base, the disparity between jaw development and the size of the teeth, and the influence of muscular unbalance. In regard to treatment, he says, "By fixed points for applying pressure, the teeth have readily yielded and have been pushed to the outer margin of the alveolar process. The dental arch has been expanded, but not the alveolar arch, and this is only reasonable when we remember that resistance to our efforts is not only offered by this bone itself, but probably to some extent also by every other bone composing the face and cranium."

Norman W. Kingsley (1829-1913), considered by many as the man of the hour and the father of orthodontia, made many constructive contributions to orthodontic literature. He devoted much time and effort to the study of both the biologic and the mechanical phases. A

review of his work reveals the fact that his concept of orthodontic problems was far in advance of the time. If he were here today, he would undoubtedly look with disdain on some of the so-called modern methods of procedure and the unsound practice initiated and carried on by commercial laboratories. Dr. Kingsley had great faith in the possibilities of orthodontic treatment. He believed that the benefits accruing to patients treated in accordance with the best knowledge of the day was invaluable and, because of the vast opportunity afforded to render a humanitarian service, predicted that orthodontia was destined to become one of the outstanding specialties of medical science.

One's concept of orthodontia is in proportion to his knowledge of important historical events. The foundation of orthodontia was not laid by any one person or by any particular group, in any one period. Rather, it was the result of contributions made by a considerable number of men over a long period of time.

Because of a limited opportunity for the dissemination of information, the absence of organization and the inability of those interested to secure training, progress was slow and tedious. It was not until the beginning of the twentieth century that a definite organized effort to advance orthodontia began.

The men from whose writings these excerpts have been taken were prominent in the field of dentistry and exerted a broad influence in its development. They gave careful attention to the study of fundamentals, an example worthy of emulation.

Many arguments that they presented in relation to the causes of malocclusion and of their treatment are still the basis of discussion. They recognized that the treatment of malocclusion involved many factors which must be overcome, and presented many problems which must be solved before successful results could be obtained. They further recognized that it was foolish and unwise to attempt treatment without a clear understanding of conditions and a full appreciation of the responsibilities to be faced before this obligation was assumed.

From B. W. Weinberger's valuable treatise "Orthodontia, an Historical Review of Its Origin and Evolution," published in 1926, in two volumes, most of the historical facts used in this paper were obtained.

The possibilities of orthodontic treatment may be divided, for the sake of discussion, into at least four parts: economics, prevention, limitations of mechanical treatment, and results of treatment.

ECONOMICS

In a discussion of that part of the subject which appertains to economics, the need of orthodontic service, the exhibited demand and the fees charged for service become propositions of considerable import.

Need of Orthodontic Service.—A conservative estimate from the best information obtainable discloses the lamentable fact that approximately 70 per cent of children are in actual need of orthodontic service. The speculative statement has frequently been made that malocclusion of the teeth is now a rule, rather than an exception, and that it is becoming more prevalent in each succeeding generation. This is an unfortunate situation, and unless provision is made for an increased amount of orthodontic service, it is certain to become serious.

Because of dissemination of information to the public through the various methods now in use, the laity is rapidly

becoming conversant with the importance of the care of the mouth and teeth as related to health, and is also fast becoming acquainted with the fact that deformities of the face and jaws can be corrected by orthodontic measures. Since a much larger percentage of children are afflicted with malocclusion than can possibly be treated under present conditions, the question becomes a critical economic problem. Immediate measures should be taken by orthodontists to establish a more even balance between the need of treatment and available service; otherwise, organizations outside the profession may attempt to remedy the situation. Solution is difficult, but it is obvious that the first step necessary is to establish graduate courses of instruction where a considerable number can be adequately trained. There should be included in these courses the subjects related to the biologic field, in which didactic and laboratory instruction should be given, and there should also be adequate facilities for teaching the fundamental principles of appliances. There should be a sufficient amount of clinical material available for demonstration and to afford the student an opportunity for practical experience.

The clinic should be operated continuously and have cases of different types in various stages of progress under treatment. The length of the course could be made variable, yet consistent with the responsibility that the student proposes to assume. I do not think that a person engaged in general practice who intends to perform only the minor operations and who is seeking information for the purpose of giving advice, practicing prevention and making a differentiation of those cases which come within his sphere and those which do not, should necessarily be required to take so complete a course of instruction as the student who expects to engage in the practice of orthodontia exclusively.

Another remedial agent lies in the organization of more comprehensive courses of instruction in the undergraduate schools. There is a wide diversity in the content of the courses given at present. A substantial improvement can be made in all of them.

Most dental educators appreciate the importance of this work and are willing to cooperate with the orthodontist in bringing about needed improvements. Spasmodic efforts have been made to standardize orthodontic teaching and to incorporate in the curriculum subject matter that will make the courses more efficient. The result of these efforts has been effective only in isolated locations.

The question of teaching orthodontia to the undergraduates has been a bone of contention for a long time, and several plans have been advanced relevant to it. One plan proposed to separate orthodontia from dentistry and set up a new profession; but this change would not relieve the present economic condition. Another idea was to educate orthodontists and all other specialists in dentistry on a lower level, and limit their privileges by law, so that they would be permitted to practice only under the supervision of a supereducated dentist. This system anticipated the training of a large number in a short time. It was predicated upon the assumption that specialists could be sufficiently educated by taking intense courses of short duration and, therefore, need not be required to take the full course of instruction as now provided in schools of dentistry. This plan would rapidly increase the number of persons certified by the schools to practice orthodontia, and, from that standpoint alone, would ulti-

mately solve the problem of providing more service. Whether this is a workable plan is a debatable question. I do not think that it is practical. If the profession is to share its part in the responsibility of caring for those in need of orthodontic service, a constructive program for the training of larger groups must be inaugurated. It seems to me that the solution of this problem is strictly the responsibility of the orthodontists. It is they who should be prepared to prescribe a formula to meet the situation.

The Exhibited Demand.—The exhibited demand for orthodontic service is another matter of concern. This may be interpreted as a demand for expert service by those who are seeking treatment. There is a clear distinction between the need of orthodontic service and the demand for it. There are about 500 orthodontists and approximately 60,000 dentists practicing in America. Patients who now apply to the orthodontists for treatment are taken care of, generally speaking, in a satisfactory manner. Those who begin treatment with a general practitioner who is not qualified to render the service are unfortunate. The majority of present-day orthodontists have received a fairly good training and are conscious of the problems to be met. They are prepared to render an intelligent service, therefore the exhibited demand from this standpoint does not cause very much anxiety. There is no great difficulty in taking care of the number of patients who are courageous enough to begin treatment.

There is another situation which commands more attention. It is probable, although there are no statistics available to confirm it, that there are more cases of malocclusion under treatment by general practitioners than by orthodontists. This would not be serious in itself if the dentists who attempted the work were qualified to render the service. In fact, it would be a blessing. The condition may be accounted for, in most part, by the practice of commercial laboratories that construct and sell orthodontic appliances, and by the deceptive advertisements of dental supply houses that market stock appliances. In both instances, consideration is given only to the question of selling the apparatus. The mechanics involved in the use of an appliance and its adaptability to individual cases are entirely ignored. This procedure does not take cognizance of the facts that the operator must have an intelligent understanding of all factors involved in treatment, and that the appliance is only a means to an end. This type of service is probably becoming more prevalent and should be condemned since it can only result in dismal failure in the large majority of cases, and may often produce an irreparable damage. This is reflected on orthodontia as a whole and may in time, if continued, contribute materially to a breaking down of the morale of the specialty.

Fees.—The question of fees is destined to evoke more attention. By reason of the fact that the care and treatment usually extends over a long period of time, and the orthodontist is required to devote a large number of hours to each individual case, the total amount to be paid in fees reaches what may be considered by most people a substantial sum. The character of the work, together with the obligations and responsibilities to the patient, demands expert service. This type of service can be delivered only by persons specifically trained in orthodontic procedures. The fees charged, in my opinion, have been

consistent, equitable and justifiable in relation to the performance required. The average fees are not excessive, although the opinion that they are seems to prevail in many quarters. The income of the orthodontists may be comparable to that of general practitioners in the upper half of the bracket. The fallacious idea that the practice of orthodontia produces large and lucrative incomes has invited the quasiorthodontist to enter the field, with the sole object of financial gain. For the same reason, the general practitioner is often enticed into an attempt to make corrections quite outside his sphere. These innovations have contributed nothing remedial, for, in some instances, exorbitant fees have been charged for a grossly inefficient and unsatisfactory service.

The unscrupulous practice of paying commissions for the reference of cases is another thing which has a disquieting influence. The person who refers the patient raises the fee in order to get a larger amount and the orthodontist raises it again to pay the excise tax, which, I understand, varies from 25 to 40 per cent; the percentage paid depending on the activity and astuteness of the competition, the business usually going to the highest bidder.

I believe that the conscientious orthodontists have endeavored to establish an equitable balance between fees and service, and have computed their charges accordingly, but, in doing so, social conditions should be taken into account. It may be wise and expedient in these times of financial stress and economic upheaval to make such adjustments in fees as seem necessary to meet this situation. This may require a considerable revision, but if so, it is in accord with the readjustments that are being made in every line of business.

While we all believe that present fees are reasonable, they are too high for a vast majority of people in need of orthodontic service. It is the care of this larger group that presents a real economic problem. The solution does not lie in the application of corrective measures, but rather in the field of prevention. Herein, the general practitioner is afforded an opportunity to render a valuable service.

PREVENTION

In the evolution of orthodontia, considerable knowledge has been accumulated which relates itself to the prevention of malocclusion. Its application has been largely misinterpreted, misdirected or neglected. Many cases which have their beginning in a small way may be prevented from developing into a serious malocclusion. This may be done by giving proper attention to environmental conditions, functional disturbances, diet, habits, deciduous and permanent dentition, development and growth and minor corrective measures. A simple method may be employed in the following type of cases: in the deciduous dentures, when the distal surfaces of the maxillary and mandibular second molars are in a vertical place, and with a deep bite in the anterior segment of the arches. When the first permanent molars erupt in such cases, they will frequently lock in an abnormal mesiodistal relationship. This can be prevented by placing bands on the maxillary second deciduous molars with a distal convexity sufficient to direct the erupting first permanent molars into their normal positions. It may be necessary occasionally to disk off a part of the distal surfaces of the mandibular second deciduous molars to allow a slight forward movement of the first permanent molars. This type of case may be observed rather frequently.

If you will remember that the combined mesiodistal diameter of the three deciduous teeth between the first permanent molar and the lateral incisor is equal to the same diameter of the three permanent teeth which are to succeed them, and conserve the full space in case any of the deciduous teeth are prematurely lost, malocclusion may be averted. The judicious extraction of deciduous teeth to permit their successors to erupt and assume their occlusal position in regular order is also advisable.

Another means of prevention is the extraction of deciduous teeth when the roots are resorbing unevenly and forcing the crowns of the oncoming permanent teeth into a malposition.

Frequent and careful roentgen-ray examinations will often indicate the use of simple remedial agents as a preventive measure.

The value of prevention in orthodontic practice has been generally underestimated. It is probable that the greatest advancement in the future will lie in this field.

LIMITATIONS OF MECHANICAL TREATMENT

The limitations of mechanical treatment are rather difficult to discuss because of the diversified avenues of approach. It may seem paradoxical, but it is nevertheless true, that the more knowledge one has and the greater experience he has gained, the more pronounced he finds the perplexities of the limitations of mechanical treatment. One may very appropriately recall that old adage, "Where ignorance is bliss, 'tis folly to be wise"; or the old saying, "Fools rush in where angels fear to tread." Almost every orthodontist has passed through the same evolutionary stages in regard to the scope and efficiency of orthodontic appliances. In the beginning, he is likely to be obsessed with the distorted idea that under his guiding hand and skilful manipulation of mechanical devices, every case of malocclusion is amenable to treatment, and he is willing to stake his reputation on the result, possibly against the advice and judgment of a more experienced man. Usually, he is not convinced of his error until after having the experience of struggling along for several years in an unsuccessful attempt to secure results. In some cases, the teeth may be placed in fairly good alinement, and the occlusal contacts placed in what appears to be a satisfactory position, when, alas, after the retention apparatus has been removed, the case collapses. The operation is repeated, and the same thing occurs. The same routine is again followed, but to no avail. In the meantime, other and more serious complications may arise. The orthodontist is chagrined, discouraged and confused. It is then that he realizes the necessity for making a more careful and thorough diagnosis and the fact that the mechanical treatment of a case is not sufficient and, after all, the school of experience is the most efficient teacher.

Let us take for example a hypothetic case which presents the following conditions: occlusal classification, Class III, Angle; age of patient, 14 years; sex, male; general physical condition below par, underweight, undersize, anemic; evidence of hereditary traits: the mother and grandfather exhibit the same characteristics; an apparent malfunction of the endocrine glands; underdeveloped maxillae with a constricted apical base; an oversized mandible with a divergent apical base; constricted nasal passages; impairment of function; muscular unbalance; an abnormally large tongue; a hypertrophied lower lip; muscular

habits; enlarged faucial tonsils; a constricted maxillary arch with lingual occlusion and buccal inclination of the cheek teeth; cuspids malalined labially; incisors in lingual occlusion with a tendency to labial inclination; the mandibular arch expanded with the teeth in buccal and labial occlusion with a lingual inclination; spaces to the mesial and distal of the bicuspids; a disparity between the size of the maxillary and mandibular teeth. Most of us will recall having seen cases which conformed closely to this description and some of us may have seen an attempt at treatment with mechanical devices alone.

May I inquire the limitations of mechanical treatment in this type of case, and how can it be determined? Do you suppose that an experienced orthodontist would presume to treat this case on the basis of restoring occlusal relationship with orthodontic appliances without making a careful diagnosis and a guarded prognosis? Do you think that results could be expected from a consideration of the occlusion only, ignoring all other related factors? Sad to relate, this practice is being followed by the neophytes and those being duped by the enticing advertisements of appliance venders.

The orthodontist or dentist who fails to recognize the cause and effect of the biologic factors in treatment, who does not make a painstaking diagnosis or make a prognosis on the basis of mechanical application alone, is doomed to utter failure in orthodontic procedure.

It may be stated in passing that there are many cases of malocclusion which are completely outside the realm of successful treatment with orthodontic appliances alone. These may be observed in patients of varying ages. There are others which, unfortunately, are hopelessly incurable. One may, not infrequently, through sympathy or something akin to it, be inveigled into undertaking the treatment of impossible cases against his better judgment. The decision is generally unwise and usually results in complications or embarrassment, and is likely to be followed by condemnation rather than appreciation.

RESULTS OF ORTHODONTIC TREATMENT

The results of treatment may be divided into two classes; namely, successes and failures. There are certain definite factors in each. The ratio of successes to failures will depend to a major degree on the integrity, quality of training and experience of the person under whose supervision and direction the case is being treated. Orthodontists, with respect to their training, fall into the following groups: those who have taken regularly organized courses of instruction; those who have gained their information and experience in association with and under the instruction of a preceptor, and those who have become orthodontists by courtesy only.

In addition, there are a large number of part-time orthodontists and general practitioners engaged in orthodontic procedures who have received their training, such as it may be, in various ways. It is reasonable to believe that a large percentage of failures occur in the treatment of cases by inferiorly trained orthodontists and persons whose interests are divided and who have only a superficial conception of orthodontic problems. It is a fact that some failures occur in the practice of properly trained and well-qualified orthodontists. In the first instance, the reasons are obvious, except that one cannot understand why an intelligent person is motivated to attempt to do a thing regarding which he has but meager knowledge.

In the second instance, failure may be

accounted for by a commission of the following errors: indisposition to correlate and apply the information available in making a diagnosis; failure to remove the cause when detectable; neglect to correct faulty habits; a committance to the use of a single type of appliance; careless procedure in technic; procrastination in making necessary adjustments; the placing of appliances in unwarranted cases; mismanagement in the application and use of an appliance; failure to establish good occlusal relationships; an attempt to treat cases that are beyond the limits of orthodontic procedure; the use of experimental methods; lack of proper prophylactic care of the mouth; inability to establish cooperation with the patient; failure to observe any nervous reactions that may arise; disregard of functional activities, and inattention to the basic principles of development and growth. A strict observance of these things is paramount if the possibilities of treatment are to be realized.

It may be apropos to discuss briefly the question as to what constitutes a success or a failure. It was the sincere belief of a prominent orthodontist of the past, whose opinion was respected by a large group and who had a following of no mean proportions, that any case in which an improvement was noticeable constituted a success. While another eminent orthodontist of the past, whose influence will undoubtedly be immortal, held tenaciously to the belief that every case was a failure in which correct occlusal relationship had not been effected and complete function restored. The first man contended that esthetics was primary and occlusion secondary. The second was uncompromising in his teaching that the reverse was true. It was upon these fundamental principles that a division of opinion occurred in regard to treatment that resulted in the promulgation and creation of what has been commonly termed the new school of orthodontia in contradistinction to the old.

If an evaluation of the results of treatment is to be based upon the first premise, all cases treated, unless normal with the exception of those in which actual damage has been done, would be put in the category of successes. While if judged in conformity with the second premise, all cases treated, unless normal occlusion has been attained and all other parts involved put in perfect balance, would be considered failures. It would appear, therefore, that the most reasonable point from which to make deduction must be somewhere between these two extremes.

The stage of perfection as interpreted by the ultracritical is but seldom reached in any case; the Utopia has not yet been attained, but it is true that major improvements are made in the large majority of cases under the care and treatment of adequately trained and experienced orthodontists. Contrariwise, serious damage may follow when they are treated by the inexperienced and incompetent.

I do not hold to the opinion that every case which does not meet the requirements of the ideal occlusion constitutes a failure. There are some in which the ideal cannot be accomplished, although conditions appear to be favorable, and others in which a compromise treatment is necessary. Those cases in which correct occlusal contacts are not even approached and those in which a permanent injury has been done must be regarded as failures.

There is another class of cases that falls into the category of failures. I refer to those amenable to treatment which have been treated over long

periods of time without much, if any, improvement, owing to procrastination, carelessness or incompetence on the part of the operator.

It is probable that every orthodontist has had cases running parallel in treatment which presented quite similar characteristics. One responded quickly and satisfactorily and caused little or no concern, while the other, for reasons unknown, persistently refused to be governed by the same methods of treatment, and frequently caused alarm and apprehension. In the first case, there must have been a complete synchronization of all factors involved, while, in the other, there probably was some inherent influence that interfered with or prevented the necessary adjustments. I have experienced such cases in my practice. They are more likely to occur in groups falling in Class II, division 1, and Class III, Angle classification. It is obvious that more information is needed relating to the mysteries that surround this class of cases.

The opinion prevails generally that development and growth in the jaws is influenced by stimulation of the cells through the medium of the teeth by the application of force with mechanical devices, and that this stimulation of the cells, together with other growth factors, causes an enlargement of the jaws and produces a harmonious relationship between the jaws and the teeth. The extent to which this may be true is not definitely known. I fear too much confidence is being placed in the efficacy of mechanical stress, and not enough consideration is given to other conditions of equal significance.

The degree to which growth may be influenced by mechanical means has not been determined. Neither has it been satisfactorily demonstrated that growth of the jaws may be retarded or arrested by constricting the dental arches with orthodontic appliances.

There are certain cases in Class II and Class III that serve to illustrate these points. In Class II, where there is an apparent disparity in size between the maxillae and the mandible, the object in treatment with mechanical devices is to harmonize the size of the jaws by retarding the growth in the maxillae and stimulate it in the mandible. In Class III, where the reverse condition is apparent, the object it to enlarge the maxillae and retard or arrest the development in the mandible. May it not be true that whatever influence is exerted will be the same in both jaws? It is possible to stimulate the cells to perform a certain phenomenon in one part and by the same means induce a reverse action in another? These things are brought forcibly to one's attention in certain cases of Class III, when it is observed that, in spite of efforts at correction, a greater disparity in the size of the jaws continues to exist.

All of these problems bear a definite relationship to the possibilities of treatment. They cannot be solved by the orthodontist alone, but will require a close cooperation and sincere collaboration with investigators in the fields of medicine and biology.

There are many things that might be said relative to the possibilities of orthodontic treatment. According to the program, there are to be reported at this meeting several cases of malocclusion treated by different orthodontists. I presume that the object of this is to demonstrate the efficiency of the various types of mechanical devices and to illustrate a cross-section of the cases in which each type is indicated. This is a commendable thing, because it will em-

phasize the necessity for acquaintance with more than one method of procedure, adding distinctly to the possibilities of orthodontic treatment.

The field of orthodontia is becoming broader and there exists a genuine appreciation for the necessity of having orthodontic service rendered. It is a specialty in which treatment is accompanied by grave responsibilities and obligations, but there is probably no accomplishment in the domain of dentistry that offers so much gratification and satisfaction as the correction of abnormalities of the face, jaws, and teeth by orthodontic measures.

The requirements of its practice demand a thorough training amplified by experience and a precision in the mechanical methods employed for the correction of malposed teeth; combined with courage, integrity and straight thinking.

It is true that there are many intricate problems related to treatment that are as yet unsolved, but we may be hopeful that the exigencies will be met as a result of the diversified investigations that are being carried on by scientific methods under capable supervision. There are thousands of cases of malocclusion treated successfully that stand as a monument to glorify the achievements and the accomplishments of the science of modern orthodontia.

DIFFICULTIES IN THE NEW MECHANISM MANIPULATION AND SUGGESTIONS FOR AVOIDING THEM*

By CHESTER F. WRIGHT, D.D.S., South Bend, Ind.

SINCE I have been engaged for the past three years in a study of the new Angle mechanism and have probably encountered during that time most of its difficulties, I know of no better way to present the subject than to recount some of the difficulties that I experienced as a student of this appliance.

Among the first problems with which I was confronted was the technic of construction. The appliance seemed to be extremely complicated as compared to those I had been using, and I assumed that a tremendous amount of time would be necessary for its assembling. I found that this difficulty had been foreseen by the author of the appliance, and that he had studied and worked out in minute detail a technic which, if followed rigidly, would give uniformly good results. This technic has been so simplified that it is foolish to try to improve on it. Hence, the first lesson was to learn the technic, by study and practice. If time is set aside for this purpose, it will amply reward the student.

The second difficulty was not so easily recognized, and not so easily overcome, once it was recognized. It took me some time to realize that I had to change my entire method of thinking about ortho-

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 20, 1932.

dontic operations in order to grasp the full significance and possibilities of the edgewise arch. The change is difficult to convey to others in a paper; it seems to have to be experienced. I shall try to indicate its nature by references to various problems familiar to all of us.

One of these problems is the use and conservation of anchorage, which is probably the most vexing problem in orthodontia. In other appliances, we think in terms of molar anchorage, even though we may enlist the aid of other teeth to increase resistance. With the new mechanism, each tooth is equipped with an attachment for stationary anchorage; and, with this increase in anchorage, the molar is reduced to the rank of other teeth. We therefore no longer think in terms of molar anchorage and individual tooth movement, but instead in terms of group anchorage and group movement.

A second difference is contributed by the ideal arch; for although the main principle is the same as in the expansion arch, in that the teeth are moved to it, its properties and the manner in which it is used are entirely different in most cases. The length and form of the expansion arch is not determined in any definite manner. In general, its form is that of a dental arch, and its length is made to reach from molar to molar around the circumference of the malformed arch. Throughout treatment, its length is increased, usually by screw force. Thus, it is constantly changing its length as well as its form. The ideal arch is given its length and form from the start. Its length is determined by actual measurement of tooth and band material, and its form is governed by typal requirements. Thus, not only its form, but also its length conforms to the dental arch in question, and each tooth has a definite place on it. The basic principles of the appliance are, therefore, different and, in treatment, demand different procedures in performing the various tooth movements.

In buccolingual movement, the chief difference is in the use of anchorage. It must be remembered that all teeth are banded, and when force is exerted on a malposed tooth in a buccal direction, a reverse force is applied to the tooth on either side. These two adjacent teeth, in turn, reverse the force as they transmit it to their neighbors. While it is true that this force rapidly diminishes as it leaves the site of initial application, the principle must ever be kept in mind or unexpected results will occur at quite remote points. With the E arch, the force would be felt on the molars, which might be assisted by ligation of the teeth of the opposite side to the arch. They would all possess simple anchorage unless special provisions were made.

In this same type of movement, namely, buccolingual, there are two other important points to be considered. One of these is the enlisting of the resiliency of the arch material for opening spaces for teeth that are to be brought out into the arch. The other is the proper handling of the ligature. The malposed tooth is tied first, which causes the arch to bend lingually, thereby drawing arch material through the brackets of the adjacent teeth, which are subsequently tied.

It will be seen that, in this way, a longer segment of arch exists between the adjacent brackets, which are caused to move apart as the arch straightens to its original form. Care must be taken when making the adjustment not to bend the arch beyond its elastic limit; which would set the arch and preclude any possibility of tooth movement. This is controlled by placing the ligature around the bracket or staple, then fastening the

free ends in the ligature, locking and tying pliers, which are held and controlled by the right hand.

Next, the arch and the tooth to be moved are grasped between the thumb and forefinger of the left hand and the elasticity of the arch is tested by gently squeezing the two together. Once this is determined, the adjustment is held with the fingers, while the pliers take up the ligature to this point and lock it. From this description it will be seen that if maximum efficiency is to be obtained, careful analysis must be made, not only in the amount of pressure used, but also in the order in which the ligatures are tied.

It has been said that the new mechanism is weak in its ability to perform rotations, and considerable difficulty is being experienced with this tooth movement. I believe that a better understanding of the placing of the bracket and staple and the possibilities for producing this movement will be helpful. Of course, it is understood that if a tooth does not require rotation, the bracket is placed in the center of the tooth and parallel with the long axis. If rotation is necessary, it may be shifted toward the side that is to act as the fulcrum, and the staple placed on the opposite side, and as far in the embrasure as the adjacent tooth will permit.

Circumstances alter cases, and it will be found that the utmost efficiency can be obtained only by considering the nature of the tooth in question and the type of rotation that is desired. In the case of a broad flat-sided tooth, such as an incisor, the procedure of moving the bracket off center will be found to be almost universally helpful. When we come to teeth which present convex surfaces, we must bear in mind the fact that this surface is going to roll on the arch, maintaining contact with it at only one point. Our aim should be to so place the bracket that as the rotation takes place, we maintain bracket control over the tooth from start to finish. This will not always be possible, for, in many cases, the staple reaches the arch before we have completed the rotation, and in these cases the band must be removed and replaced in such manner that the staple is once more in the embrasure.

The other point to be remembered in dealing with rotations is the type of rotation desired in any particular case. We recognize three distinct types: in the first, the rotations are to move the tooth on its own axis; in the second, one corner of the tooth is to be brough to the arch, while the other is maintained in its position, and, in the third, one side is to be maintained, while the other is to be pushed away from the arch.

It goes without saying that the staple is always placed on the side of pull, while the other side is controlled by various pushing forces, depending on the requirements. In the first type of rotation, the high point of the tooth in contact with the arch acts as a fulcrum, which will give us equal and opposite movements of the two sides of the tooth by simply tying to the staple. Where it is desired to push one side of a tooth away from the arch, the ligature is tied through the staple on the opposite side; and, on the moving side, we can use one of three procedures: 1. A tiny piece of rubber band may be placed in the floor of the bracket if this fixture is located at the bearing point. 2. A spur or block of metal may be soldered to the lingual side of the arch so that it acts as the bearing point. 3. A block of orthodontic rubber may be inserted between arch and tooth, a spur being soldered on to confine its action to the area we wish to be acted on.

As far as elevations and depressions are concerned, it will be found that these are taken care of almost automatically. It is apparent that if the bands occupy their correct position on the tooth occluso-gingivally, and if the arch is correctly formed and contains its normal curve of Spee, when the brackets come to engage the arch, the teeth will be at their proper level. There is one instance in which a discussion of the manipulation of the arch may be of some assistance. The condition occurs in the mandible when the contact has broken at the distal aspect of the cuspid and the six anterior teeth are found in supraclusion. Thus, the arch presents two planes of occlusal surfaces, one occupied by all of the posterior teeth and the other by the six anterior teeth. The problem is a lengthening of the arch as the occlusal plane is leveled off. When the arch is slipped in the molar tubes, it will be found to lie gingivally to the anterior brackets.

At this point, the procedure must be determined by the condition to be met. We have the choice of engaging the buccal brackets and leaving the arch gingivally to the incisor brackets, or of engaging the incisor brackets and leaving the arch occlusally to the buccal brackets. If treatment calls for a depression of the incisors without any labial tipping of their crowns, in short, stationary anchorage, we ligate into the incisor brackets. If a depression plus a labial tip of the incisors is desired, we ligate into the buccal brackets and tie the arch to the anterior brackets by merely throwing the ligatures over the incisal wings of the brackets and drawing the arch up.

The problems that we have considered so far are those which have their parallel in all other types of orthodontic mechanisms, and an effort has been made to show how they are handled with this appliance. When we come to mesial and distal movement of teeth, the edgewise arch introduces principles that are entirely different from those of other appliances, and there has been considerable confusion caused by this new departure. Let us study these differences, and perhaps we can throw some light on the difficulties being encountered.

Until the introduction of the new mechanism, teeth have been moved along the arch with the arch considered as a fixed base. For example, in lingual arch treatment, the metal arch is made to conform to the lingual surface of the malformed dental arch and, from this as a base, finger springs are employed to expand and lengthen the dental arch, with the molars furnishing the anchorage. The teeth move away from the metal arch and, as they do so, spaces are created between them. To close the contacts and localize the space where needed, additional springs are added. Thus, the teeth change their relation to the arch throughout treatment.

If we examine distal movement of the maxillary denture with the E arch, we find that it is accomplished by banding the first molar and adjusting an arch to lie passive gingivally to the incisors. The arch is then sprung occlusally and ligated to the anterior teeth. The result is a simple lever acting on the molar which produces a mesial elevating force on that tooth. Then, by tightening of the sleeve nut, the molar is carried distally. After it has started its distal movement, the bicuspids are tied to the distal aspect of the molar tube, or they may be carried from the start by means of lingual extensions; but, regardless of this detail, the arch is constantly increasing in length, and consequently the teeth are changing their relation to it. When the molar and bicuspids have reached their desired position,

the nuts are freed of the molar tube and the arch is again shortened, as the force of the intermaxillary elastics carries the anterior teeth back. Here again, we see the arch used as a base along which teeth are moved. As ribbon arch treatment is essentially the same, we need not take the time for analysis of its principle.

We might examine distal or mesial movement of but one segment for the purpose of opening or closing spaces, but it will not be necessary, for it is the same. The plan and the principle is to move teeth individually along an arch which acts as a fixed base.

This same plan may be used with the new mechanism wherever desired, but, with the new mechanism, it is possible to move entire segments at the same time in the same direction, and without changing the relation of individual teeth to each other, or to the metal arch, for the arch travels with the teeth. This principle of the arch traveling with the teeth brings us to a consideration of second order bends and torque. Although applied for different purposes and in different directions, and although different mechanical principles are involved, the effectiveness of these two forces depends on identically the same physiologic principle.

Prior to 1911, certain theories existed regarding bone changes incident to tooth movement; and, even though these theories differed, they all agreed that, on application of pressure, the tooth moved with a fulcrum somewhere between the alveolar crest and the apex. For example, when pressure was applied to the tooth, the crown moved in the direction of pressure,while the apex moved in the opposite direction. In 1911, Dr. Oppenheim, of Vienna, published a report of his research on this problem and established the fact that the former theories of tooth movement were not correct. His findings indicate that when force, by means of a ligature, is applied to a tooth, the first reaction takes place at the tip of the gingival border by a reorientation of the bone. New bone is built on the side of pull of the peridental fibers, while bone is absorbed ahead of the direction of movement on the side of elimination of pressure. At the end of forty days, this process of absorption and rebuilding had progressed two-thirds the length of the root without any change occurring at the apex. We may then assume that, by continued application of pressure, this process would have continued to the apex. Thus, the fact was established that the movement was that of a one arm lever with its fulcrum at the apex of the tooth root. With the introduction of the bracket method of fastening the arch to the teeth, it became possible to move teeth bodily through the bone, and thus to change or to determine whether we wished the root apex to remain in its position or to move.

In either second order or torque movement, the fulcrum is caused to remain at the apex. If we examine the forces that we bring into play through these bends, we can understand the resulting action. After the step bends have been made, examination of the arch will reveal that it is composed of levers. Now if the arch end is slipped into the molar tube, the arch will be found to lie high above the second biscuspid bracket. When the arch is pulled occlusally and sprung into the second bicuspid bracket, a mesial elevating and backward force is produced on the molar which is exactly the same as is produced in E arch or ribbon arch mechanics. The anchorage is the second bicuspid instead of the incisors

the tooth which is receiving a reciprocal distal depressing force. When these mechanical forces are carried forward and the first bicuspid lever is sprung into position, there is a mesial elevating force applied to the second bicuspid from the first bicuspid, the distal side of which receives a depressing force. The same mechanical forces are applied to the first bicuspid when the cuspid lever is sprung into position. At the mesial aspect of the cuspid, these mechanical forces cease, and the mesial elevating force on the cuspid is derived from the incisors, which are moved backward solely by the elastics. To sum up the distribution of forces: we find that all four teeth in the buccal segment are receiving a mesial elevating force, while the cuspid and both bicuspids are receiving a distal depressing force.

It will be seen from this analysis that a new fulcrum has been established at the bracket and that if the arch is held from moving in either a mesial or a distal direction, the root apex would be moved forward; but an additional force is supplied when the intermaxillary elastics are added and the entire arch is caused to move distally, which again changes the fulcrum to the root apex. In order to further explain these mechanics, let us consider any tooth in the right buccal segment as isolated and equipped with an attachment containing a square slot. If a square key is placed in the slot and turned in a clockwise direction, at the same time preventing the hand from moving in either direction in the horizontal plane, a forward movement of the root apex would result with the slot as a fulcrum. Now, if this same attachment is used, but the hand is allowed or caused to move distally as the force is applied, the tooth will move distally with the apex as the fulcrum.

Since the teeth are equipped with brackets which possess parallel sides, and the arch exactly fits, we have the same sort of attachment as the square socket and key. Therefore, the arch must be free to move with the teeth if distal movement is obtained, just as the hand traveled with the key; otherwise, a forward movement of the root apex would result from the step bends instead of the desired movement.

The rôle of the elastics at once becomes apparent, and I am positive that some of the difficulties being encountered are caused by their intermittent application. So positive is the force just described that we do not need to ask, we can tell, the patient whether the elastics are being worn. After the vertical bends have been placed and the elastics are added, and when the patient returns, we note whether the teeth have changed their mesiodistal relationship to the teeth in the opposing arch. If they have, we may rest assured that the patient has worn the elastics. If the teeth have not changed their mesiodistal relationship, but have changed their axial inclination, we can tell the patient that he has not followed instructions and not fear that we have accused him unjustly, regardless of what he may say to the contrary, for these mechanical principles are fixed.

Not only do the teeth move distally *en masse,* but, unlike movement with the E arch which results in spaces being opened, contact will be maintained throughout the distal movement. To begin with, the arch has a given length, determined by the amount of tooth substance. This arch lies in the horizontal plane and contains no bends. When bends are placed in the vertical plane, it is apparent that it will be shortened by reason of the fact that a straight line

is the shortest distance between two points; but when the arch is sprung into the brackets, it is again lengthened and its tendency is to return to the shortened state as the force is expended. Because of this principle, in the arch we see that, throughout distal movement, the contacts are kept tight. Not only this, but, by proper placing of the vertical bends, spaces can be closed as the teeth move distally.

So far, our consideration of the vertical bends has been of the movement of teeth in the same direction simultaneously. This same procedure, or use of the vertical bends, may be employed in opening spaces, if the principle just discussed is followed. In explanation, let us consider a specific example: Suppose, from case analysis, it had been determined that the bicuspids and molar on one side, or both, are to be moved distally to open space for the cuspids, while the anterior teeth are not to be moved. After the arch engages the brackets on the teeth to be moved distally, it is marked in the usual way for the vertical bends. The bends are made and the arch inserted, but it is carried one sixteenth inch forward of the incisors, because the arch must be free to travel with the teeth, and if it were in contact with these teeth, it would not be free. This freedom must be maintained throughout the distal movement of the buccal teeth by bringing the arch forward of the incisors at each adjustment. If the arch were not so relieved, it would carry the incisors backward as it traveled with the buccal teeth.

Since, in the application of these mechanical principles, the teeth are tipped, it is apparent that when the crowns have reached their desired mesiodistal relationships, the teeth present a distal inclination. In all former mechanisms, at this point, the appliances are removed, and the teeth allowed to go free, to be straightened by occlusion. With the new mechanism, we go one step farther, and this procedure seems to be little understood. You will remember that the slot is placed at right angle to the long axis of the tooth. Therefore, when the teeth are tipped, the slot will incline from above in back to below in front, so that, if a straight arch were inserted, the reverse pressures would be operating; namely, a distal elevating and mesial depressing force. If the arch were held, the resultant action would be a distal root movement. This is what is meant by reversing the mechanical force and it is accomplished by gradually removing the vertical bends as the elastics are worn to hold the arch. In this way, the teeth assume their correct axial relationships.

The placing of the staple is also important when it is used in conjunction with second order bends, for they can be so placed that they will lock the mechanical force of these bends. In distal movement, the cuspid and both bicuspids are receiving a distal depressing and mesial elevating force, which causes them to swing in an arc so that, as they move, the distal-occlusal and mesial-gingival movements are toward a straight line, drawn through the center of the brackets, while the distal-gingival and mesial-occlusal movements are away from this straight line. The staple must be so placed that, as the tooth moves, it travels toward the arch, which calls for its placing on the distoclusal aspect, or if the tooth requires the opposite rotation, it must then be placed on the mesiogingival. It will be seen that, if so placed, the staple not only travels toward the arch, but also assists the movement by reason of the fact that it increases the length of the lever. It will also be seen that, if

placed in reverse positions when the ligatures are tied, which draws the arch toward the staple, it virtually removes the force of the bend and renders the mechanical force inactive.

To sum up the points to be remembered in the use of the second order bends: We must know (1) the principle of the arch traveling with the teeth to effect movements of the crowns, and holding the arch from traveling to effect root movement; (2) the purpose of the elastics and the necessity of their constant application when the bends are in action, and (3) the correct placing of the staple.

Now we may turn our attention to twists placed in the arch in the direction of its long axis. These twists occasion more difficulty than any other arch modification; but an understanding of the forces which they produce and their underlying principles will be helpful. Here again, we must remember that all teeth are banded; that, to every action, there is an opposite and equal reaction on all the remaining teeth in the dental arch, and these actions and reactions must be reckoned with. The mechanical force of torque, like that of second order bends, causes the teeth to move with the fulcrum at the apex of the tooth root, if the arch is free to travel in the horizontal plane. If the arch is held, a root movement in a labial, buccal or lingual direction results. This implies that if a buccal crown movement of the entire segment of the dental arch is desired, it is necessary for the arch to move in a buccal direction as well. To examine some of these forces: If a molar arch segment is torqued for buccal crown movement and slipped into the molar tube, the arch will lie gingivally to the brackets on the opposite molar. This is exactly the mechanical principle used in the ribbon arch, where the next point of attachment anterior to the molar is in the anterior segment, which lies in a different plane of space. As we have seen, in second order bends, the next point of attachment with the edgewise arch is the second bicuspid, and this tooth lying in the same plane of space would receive an equal and opposite twist, which is not desired. To overcome this, buccal torque is placed in the arch controlling this tooth, which throws the load on the next tooth forward, the first bicuspid. Thus, we go forward step by step to the cuspid, each tooth being torqued slightly in the same direction. Torque, like second order bends, operates only in a straight line, and as we round the corner at the cuspid, the twist force in the buccal segment becomes a straight elevating or depressing force on the incisors and these teeth become the operating base, as in ribbon arch treatment. If buccal movement of the crowns of all the teeth in the buccal segment is desired, the original torque bend for the molar is the same, but to get the same action on the remaining teeth, the bends must be increased on each tooth as we come forward, again with expansion in the arch. If the bends are not increased, it will be seen that, at the beginning, there will be unequal forces on the teeth, since the force diminishes as we leave the molar and go forward, but, if the bends are increased, the result is equal pressures on all the teeth, which causes them to move equally and at the same time.

There is this to be remembered about torque: It has its indications and, in many instances, it can be enlisted to increase the efficiency of the appliance in performing various tooth movements. Because of the nature of the attachment of the tooth to the bone at the root apex, teeth usually change their position by a

tipping movement; therefore, the arch, when given its ideal form, contains natural torque in relation to the bracket. Torque bends should be used only when absolutely necessary, for it will be found that the closer the arch adheres to the ideal, the fewer the difficulties, and the less uncertainty accompanying its manipulation.

In the use of second order and torque bends, the dental arch must be thought of as consisting of three segments: two buccal and one anterior; for force travels in a straight line and, therefore, these bends do not operate as a principle beyond the cuspids. Second order bends, or torque, in the buccal segments resolve themselves into elevating or depressing force in the anterior segment. Torque in the anterior segment resolves itself into either elevation or depression in the buccal segments.

In a number of cases, it will be found that equal and opposite movement is desired on both sides of the arch; for instance, where we desire expansion and buccal torque of both buccal segments. In this type of case, the torque of one side can be played against the torque of the opposite side without the intervention of the incisors, but it must always be remembered that, as the buccal segments go buccally, the anterior segment of the metal arch will be drawn backward, and unless allowance is made for this by clearing the teeth, they will be dragged with the arch, or they may even lock the mechanical force.

It should be apparent that there is no step in the handling of the appliance that is not important. From the time we decide on what needs to be done, in any given case, we must be exact and thorough in both our technic and our thinking. The placing of the bands, the placing of the staples, the initial formation and application of the ideal arch and the bending and manipulating of the arch are of equal importance if the fullest efficiency is to be realized. Whatever is put into this arch through the medium of the brackets, whether intentional or unintentional, will show itself, and the only way to avoid the embarrassment of unexpected results is to know the possibilities of every procedure.

724 Sherland Building.

ROENTGENOGRAMS OF MORE THAN PASSING INTEREST: CASE REPORTS

By T. ANDREW BUCKLEY, Ph.G., D.D.S., Mount Vernon, N. Y.

CASE 1.—S., housewife, aged 27, referred by her physician, March 4, 1931, gave the following history: Her father had died at

Fig. 1 (Case 1).—Fully developed tooth in anterior part of mandible below coronoid process.

Fig. 2 (Case 2).—Granular material resembling dental cement in maxillary sinus.

the age of 55, of cancer of the stomach. Her mother, three brothers and two sisters were living and well. The patient had had the usual childhood diseases. Menstruation began at 17 years, with regular periods of from four to five days' duration, and attended by pain. At the age of 20, the patient had scarlet fever and the same year she underwent appendectomy. There was an ectopic pregnancy (right side) at 22, and three months later a left tubal-ovarian abscess developed because gauze had been left in the abdomen at the previous operation. The right kidney was removed in 1928 because of nephro-

Fig. 3 (Case 3).—Fistula connecting root apex and antral cavity.

lithiasis. Tonsillectomy was performed in 1929. The patient had married in 1924. There had been no miscarriages and no abortions.

The present complaint was severe temporal and frontal headache, occurring more or less continuously for the past three years, sometimes on the right side and sometimes on the left, and with occasional attacks of vomiting. The headaches had started nine years previously, occurring periodically. Acetylsalicylic

acid afforded relief. For the past two years, the patient had been taking codein and as much as 50 to 60 grains of acetylsalicylic acid daily. There were no other complaints. The urinary symptoms were negative as were the gastro-intestinal, except for irregular vomiting, probably due to gastric irritation from large quantities of medicine taken. The physical examination was otherwise negative. A roentgenogram had been taken of the skull two years previously.

Brain tumor was suspected and the patient was admitted to hospital. No tumor was found, but the roentgenologist called the attention of the surgeon to a fully developed tooth in the anterior portion of the mandible, just below the coronoid process. The following day, the tooth was removed in the office under local anesthesia. Sodium amytal, 3 grains, was administered half an hour before the patient was placed in the chair.

A long incision was made at the anterior border of the ramus. After separation of the mucoperiosteal flap and temporal muscle, a surgical bur was used to uncover the tooth, which was dissected free from the osseous tissue. The cystic membrane was removed, with curettage of the socket, and warm saline irrigation, and sutures and a drain were inserted.

The patient suffered no after-pain, and but very slight trismus. The headaches disappeared the following day for the first time in several years. March 19, the patient was discharged. Six months later, she was having an occasional headache. Pathosis may be noted about other teeth in the patient's mouth, which will be cleared up subsequently.

Case 2.—Mrs. M. was referred by her physician for tooth extraction. On roentgen-ray examination (intra-oral film), a suspicious opaque area was noted at the upper margin. Anteroposterior and lateral plates revealed a foreign body of unknown origin within the maxillary sinus. The upper first molar had been extracted, with opening of the antrum and subsequent treatments by a rhinologist thirteen years previously, and the patient had received medical and surgical treatment, at various places and times, since that time.

There had been pain and tenderness over the right antrum for twelve years and shooting pains in the right ear. The patient complained of general weakness. The eyes watered and were painful. Right frontal headache, and postnasal discharge were also complained of. Tonsillectomy and adenoidectomy had been performed.

Anemia, heart disease, kidney disease and hay fever were diagnosed, with foreign body in the right antrum and chronic right sinusitis.

Radical operation, performed under a general anesthetic, with the assistance of the patient's rhinologist, revealed that the foreign body was a quantity of granular material resembling dental cement.

After one year, the patient reported great improvement in health.

Case 3.—Mrs. E., referred by her dentist, had a large cystic area of the upper right side. Lipiodol was injected in the maxillary sinus to determine the extent of invasion. The rhinologist injected the opposite side by mistake, and the plate shows very clearly the fistula connecting the root apex and the antral cavity.

The Journal of the American Dental Association

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Editorials

THE BUFFALO MEETING

The Seventy-Fourth Annual Session of the American Dental Association convened at Buffalo, N. Y., Sept. 12-16, 1932.

The attendance, as might have been anticipated owing to prevailing industrial conditions, was not quite up to the usual quota, but, in consideration of everything, the Association may well be congratulated on the showing made. It is impossible at this writing to state the exact attendance, but it was practically 6,000. This may be considered remarkable in view of the financial stress that has gripped our citizens generally, and it speaks well for the loyalty and professional interest of the personnel of the Association.

It would seem that the acme of service had been manifest in our previous local committees. Each committee seems to vie with previous committees, and this is really the spirit in which they should work. The Buffalo committee headed by the faithful and energetic G. G. Pritchard, in cooperation with Miss Charlotte Becraft, who for years has been executive secretary to each local

committee, staged a meeting that was never excelled. To a man, the committee devoted themselves to the welfare of the Association and to the comfort of the members, and their teamwork and efficiency were demonstrated through the entire meeting. The Association owes them a deep debt of gratitude.

The weather was favorable in every way, and this added much to the enjoyment of the visitors. Distinguished members of the profession from abroad graced the meeting. Among these were noted Drs. A. J. Arnott of Sydney, Australia, and A. L. Hipwell and F. J. Wilson of Paris, France, together with a large delegation from Canada. The attendance of the Canadian contingent is becoming a regular and most pleasing feature of our annual meetings, and it lends a fraternal spirit which conduces to cooperation and comradeship between members of the profession of the two countries.

The President's address to the delegates, which was published just previous to the meeting, elicited a very spirited discussion, as was only natural in view of the important issues under consideration. Owing to the apparent confusion in which the question of publicity was involved, it was finally decided to defer definite action for another year so that the issue may be clarified and dealt with in an equitable manner. During all the discussion on this and other controversial matters, the President, Dr. Dewey, conducted the various meetings in an able manner, and in strict accordance with parliamentary procedure. His task was not always easy.

Another officer of the Association to whom reference should be made at this time is the Secretary of the Association, Dr. Pinney. During the entire meeting, and in fact for a long period before the meeting was held, the Secretary devoted his best energies toward the success of the meeting, and was indefatigable in season and out in promoting the interests of the organization. Much of the success of the meeting was due to his initiative and faithfulness.

The Scientific Sections were for the most part well attended and elicited much interest, the basis of which will appear in the form of papers to be published in subsequent issues of THE JOURNAL.

A really outstanding feature of the meeting, as it concerned

the public, was the character and fullness of the press reports. We have never seen a more comprehensive or dignified presentation of any meeting than was given by the newspapers of Buffalo; and the profession generally, to say nothing of our own membership, are under deep obligation to the public press for their cordial and constructive report of this meeting. The days of buffoonery and ridicule in connection with public reports of our professional gatherings seem to be past, much to the benefit of both the public and the profession.

Something also should be said about the Buffalo hotels. If ever the managers of hotels outdid themselves in courtesy and consideration on behalf of their guests, it was done at Buffalo. From the manager to the bellhop, every employe demonstrated the utmost solicitude for the comfort of the visitors, and this contributed in great measure to make the meeting a success.

One of the pleasant features of the Buffalo meeting related to the display put up by the exhibitors. There is no question of the vital interest that our members have in the annual exhibits. It is in a sense an education on the latest advances in our technical development, and safeguarded as it usually is by the exhibit committee, it can result in nothing but good.

In connection with staging the meeting, mention should be made of the facilities provided in the 174th Armory where the section meetings and clinics were held. Everything possible was done to further the interests of the meeting and to provide a satisfactory and most comfortable setting. Ample facilities were furnished for the accommodation of the scientific sections, the clinical program and the exhibitors' space. The management of the Armory may well receive the congratulations and commendation of our entire membership.

The incoming officers are:

President, G. Walter Dittmar
President Elect, A. C. Wherry
Secretary, H. B. Pinney
Treasurer, R. H. Volland
Vice Presidents, G. G. Pritchard, Franklin G. Clemmer and Olin Kirkland

As voted by the House of Delegates, the next meeting will be held in Chicago in conjunction with the Century of Progress Dental Congress, Aug. 7-12, 1933.

WHAT ABOUT SALIVARY CALCULUS?

We hear a great deal in our literature about dental caries, and faith, we need to hear it. Till the etiology of caries is cleared up, we stand convicted of dereliction of duty, and our research workers and our clinicians must keep incessantly at it till the problem is solved. Speed the day when we shall know the real and significant agency that is accountable for caries, to the end that we may logically proceed to its elimination.

But what shall we say of that other scourge, salivary calculus? We hear so little about it today that the impression might well go abroad in the profession and among the people that it was not a matter of any moment, when the fact is that it causes nearly as great havoc as does caries itself. The conscientious practitioner spends almost as much time in removing calculus and combating its influence as he does in checking caries, and it is high time that the profession begin to raise some pertinent questions in connection with it.

A few of the questions may be listed as follows: Why do we find calculus in one mouth and not in another? Why does it vary in the same mouth at different times? Why do we have a deposition of calculus at all? The answer to these questions cannot be stated in the mere matter of cleanliness or uncleanliness.

It is true that an honest effort on the part of the individual may tend to limit the amount of deposit on the teeth, but, with certain persons, a faithful brushing of the teeth will not entirely eliminate the deposit, while with others there will be little or no deposit even though the teeth are not cared for in any way.

Something more should be done about this than has ever been done in the past. Let our research men formulate all of the theories that have been advanced to date, and, on the basis of these, let

them start anew on an investigation that shall discover the answers to the questions that the members of the profession are most desirous of knowing.

At this time, we would hazard the guess that when this question is finally solved, it will be found to involve some fundamental ideas concerning diet, assimilation and elimination. It is easy to say that calculus comes from the saliva; but why? Is it because the saliva becomes so overladen with inorganic material that the fluid part cannot hold the inorganic in solution? Or is it because there is some lack of balance in the normally prescribed relation between the solid and fluid constituents of the saliva whereby calculus is formed? And if this is true, why is it?

Since the investigations of G. V. Black (1912, *Dental Review,* page 337) on the subject of salivary calculus, little of a concrete character has been evolved, but Dr. Black did not conclude his study of the subject. It was his idea that overeating, particularly of certain articles of food, induced the deposition of calculus, and he was able to deposit on a cover glass attached to his denture spiculae of calculus at will. But there is something more than excess diet to account for the phenomena of calculus.

At the time that Dr. Black was making his study, he requested the writer of this article to note clinically the manifestations of overeating on the part of patients, and its relation to the deposition of calculus. The very worst case of prolific calculus deposit occurred in a patient who, for the previous six months, had been on the strictest diet and, as the patient remarked, had "eaten hardly anything." When this was reported to Dr. Black, his laconic remark was: "We don't know much of anything." But the fact is that Dr. Black had learned more concerning salivary calculus than was manifest on the surface. He had learned that there was something associated with the saliva that was most significant in connection with the deposition of calculus, but, at that time, he was engrossed with other problems and the opportunity never came for him to follow his studies in saliva to a definite conclusion.

It would seem that the time is now propitious for some of our research workers to take up the further study of salivary calculus

and try to throw more light on this perplexing problem, to the end that an affection as prevalent as this shall eventually be cleared up and the public be given the benefit of a certain knowledge regarding a condition that has too long been clouded in obscurity.

MARK F. FINLEY, D.D.S.

(1856-1932)

Mark F. Finley was born in Ypsilanti, Mich., July 9, 1856; died, September 9, after a long illness.

Dr. Finley attended the Michigan State Normal school after graduating from high school and then took a course in the University of Michigan College of Dentistry, graduating in 1878. He went to Washington, D. C., a few years after his graduation and there he resided until his death.

Dr. Finley was widely known in his profession, which he followed for fifty years. He served as President of the American Dental Association in 1906, and had also been a president of the National Board of Dental Examiners, the District of Columbia Dental Society and the Washington Dental Society. He was at one time professor of clinical dentistry at Georgetown University. In addition to his professional activities, he had many lodge and club interests. In 1925, he acted as president of the District of Columbia Sons of the Revolution, and he was a Past Grand Master in Masonry. He was active in the affairs of the Church of the Epiphany, was a charter member of the University Club and a director of the Federal-American National Bank. At the time of his death, he was acting treasurer of nine organizations.

Two sons, Mark F., Jr., and John T., survive, as well as a brother Col. John D. Finley, U. S. A., retired. Mrs. Finley died in 1909.

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association for inclusion in the list of Accepted Dental Remedies. The Council desires dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules which govern the Council in the consideration of articles will be sent on request.

SAMUEL M. GORDON, *Secretary.*

SODIUM PERBORATE, FLAVORED—HENNEN. A brand of sodium perborate, N. F. V, flavored with oil of sassafras, 2.9 per cent.

Actions and Uses: See Sodium Perborate, N. F. V, THE JOURNAL, October, 1931, p. 2010.

Manufacturer: Hennen Products, Wheeling, W. Va. No U. S. patents or trademark.

HENNEN'S TOOTH POWDER. Composition: According to the manufacturer, each 100 gm. contains (approximately) Castile soap, 7 gm.; calcium carbonate, precipitated, 87 gm.; glycerin, 2 gm.; sodium chlorid, 2 gm.; oil of peppermint, 1 gm.; methyl salicylate, 0.5 gm.; tincture of orris root, 0.1 gm.; saccharin, U.S.P., 0.13 gm.

Claims: The manufacturer agrees to make no claims except that this powder acts as a cleansing agent when used in conjunction with a toothbrush.

Manufacturer: Hennen Products, Wheeling, W. Va. No U. S. patents or trademark.

IRON AND IRON COMPOUNDS

The Council has adopted the following chapter on iron and iron compounds for Accepted Dental Remedies.

SAMUEL M. GORDON, *Secretary.*

The principal use of iron and iron compounds in general therapeutics is as a hematinic. Less frequently, it is used as an astringent and as a styptic, which accounts for its place in dental therapeutics. The latter actions are due to the properties which it possesses in common with other metallic ions of action on, or precipitating, protein material to form insoluble compounds. Iron is essentially different from most other heavy metals in being necessary to the life of perhaps all forms of protoplasm. It forms an essential part of the hemoglobin molecule.

The forms of iron which are of principal use in dentistry are those in which iron occurs in the ionic form. Such compounds listed in A.D.R. are ferrous sulphate, ferric chlorid and ferric subsulphate (Monsel's solution, N. F. V). In general

therapeutics, it is used (1) in the form of metallic or elementary iron (reduced iron, U.S.P.); (2) in the ferrous or unoxidized form, responding to tests for the ferrous iron (ferrous carbonate in mass and pills of ferrous carbonate and ferrous iodid in syrup of ferrous iodid); (3) in the trivalent or oxidized form the ferric compounds, responding to tests for the ferric ion (ferric chlorid in tincture of ferric chlorid, U.S.P.) and complex compounds of iron.

The reduced iron and several of the carbonate preparations are used exclusively in the treatment of anemia, as they are practically devoid of irritant properties and are among the best of all iron preparations for this purpose.

Complex iron compounds are those compounds of iron whose solutions do not respond to the common tests for ferrous or ferric ions, because the iron is part of a radical; nor do they have the astringent properties of the simple iron solutions. Hence, for the purposes of astringency, their use appears irrational.

Actions and Uses.—Solutions of ferric iron have been used extensively. Iron salts, notably ferric subsulphate (Monsel's solution), have been used extensively in dentistry as astringents. On account of their property of staining teeth, they can be replaced with advantage by less harmful astringents, such as epinephrin or thromboplastin. In profuse hemorrhage, their efficiency as a coagulant is low.[1]

The perchlorid and the subsulphate are used as styptics and act by precipitating the proteins of the blood, thus forming an obstruction to the flow of blood from the wounded vessels. Such treatment is of value only for oozing from capillaries or small arterioles. To be effective, the iron must be brought in immediate contact with the bleeding point.

As already indicated, the principal use of iron is in the treatment of certain forms of anemia and chlorosis. As certain of the ferric salts readily destroy the enamel and cause a pronounced black coloration of the teeth, the ferrous salts are to be preferred for this purpose. Reduced and ferrous iron do not destroy the teeth.

Because of improvement in general hygiene in later years, chlorosis has become an increasingly rare disease. Suitable diet (especially liver, kidney, meat and spinach) is sometimes more effective than the iron preparations alone, presumably through the interplay of other factors, probably organic in nature, since liver extract, which is practically iron free, is of no value in secondary anemia, although effective in pernicious anemia.

There is no adequate evidence that iron compounds, either simple or complex, are related to the problem of calcification, as asserted by some authors. The intake from food sources is ordinarily more than sufficient for the needs of the average person.

FERROUS SULPHATE, U.S.P., Ferri Sulphas (Ferr. Sulph.), Green Vitriol.—$FeSO_4.7H_2O$.

Properties: Ferrous sulphate occurs as pale bluish green crystals, without odor, having a saline, styptic taste. It is efflorescent in dry air. It is freely soluble in water (1 in 1.4).

Actions and Uses: In common with other metallic salts, and iron salts in particular, iron sulphate is an active astringent. It is claimed to be inferior to copper sulphate for application to canker sores. It may be applied in substance or solution.

1. Hanzlik, P. J.: J. Pharm. & Exper. Therap., 12:71 (Sept.) 1918.

It is sometimes administered in pills as a hematinic. It was formerly used as a disinfectant and deodorant, but is not often employed for that purpose now.

Dosage: As an astringent, in substance or in solution, when it is given internally, the dosage is 0.1 gm. (1½ grains).

FERRIC CHLORID, U.S.P., Ferri Chloridum (Ferr. Chlor.). Iron Perchlorid, Sesquichlorid of Iron.—Ferric Chlorid—$FeCl_3$ with water of hydration.

Properties: The orange-yellow crystalline deliquescent pieces are odorless, and have a strongly styptic taste. They are readily soluble in water (1 in 0.2), and freely soluble in alcohol.

Incompatibilities: It is incompatible with tannin, the vegetable astringents (which give an inky color to the mixture), and with alkalis and alkali carbonates. Tincture of ferric chlorid is also incompatible with iodids, from which it liberates iodin.

Actions and Uses: In medicine, it is used mainly in the form of the tincture. It is an astringent and is used in application to the mucous membranes, particularly of the throat. It is used in the control of hemorrhage, after the extraction of teeth, the removal of small growths, etc. It may be employed as a hematinic, but often disturbs digestion. The tincture has a deleterious effect on the teeth and hence should be used with caution.

Dosage: As an astringent, it is taken in substance or in tincture.

TINCTURE OF FERRIC CHLORID, U.S.P., Tinctura Ferri Chloridi (Tr. Ferr. Chlor.), Tincture of Iron. A hydroalcoholic solution of $FeCl_3$, containing about 13 per cent of the anhydrous salt, corresponding to not less than 4.48 per cent of metallic iron (Fe).

Properties: Tincture of ferric chlorid is a bright amber-colored liquid having a slightly ethereal odor, a very astringent taste and an acid reaction. It is miscible in all proportions with either water or alcohol.

FERRIC SUBSULPHATE, Ferri Subsulphas (Ferr. Subsulph.), Monsel's salt. This is used in dentistry principally as solution of ferric subsulphate (N.F.V) Monsel's solution.

Liquor ferric subsulphate (Liq. Ferr. Subsulph.) —An aqueous solution of ferric subsulphate, containing about 20 gm. of Fe in each 100 c.c.

Properties: Monsel's solution is a dark, reddish brown liquid, odorless or nearly so, of an acid, strongly styptic taste, and miscible with water and alcohol without decomposition.

Incompatibilities: It forms insoluble compounds with tannin and tannic acid, hydroxids and sulphids and, in general, with metal precipitants.

Action and Uses: Monsel's solution acts as a prompt styptic. As such, it has been used in dentistry for the control of hemorrhage after the extraction of teeth. The solution may be soaked in cotton for packing in the socket, after washing. It should not be used internally.

THE ANNUAL REPORT OF THE COUNCIL ON DENTAL THERAPEUTICS

The Annual Report of the Council on Dental Therapeutics which was presented to the Officers and to the House of Delegates at the Buffalo meeting of the Association is presented by arrangement with the Editor. Constructive criticism concerning the work of the Council and of the A.D.A. Bureau of Chemistry will be welcome.

SAMUEL M. GORDON, *Secretary.*

The work of the Council on Dental Therapeutics continues to fill a definite need in the scientific affairs of the Association. Commendatory reports and communications continue to be received. These are best exemplified by the attitude of teachers as expressed in the following resolution by the American Association of Dental Schools at its meeting in April, 1932:

In view of the usefulness and importance of the work of the Council on Dental Therapeutics of the American Dental Association to the members of the dental profession, we therefore wish to present this resolution:

WHEREAS, in recognition of the weaknesses and the abuses which exist in the field of therapeutics as it applies to dentistry, and

WHEREAS, in recognition of this fact, the American Dental Association has created the Council on Dental Therapeutics; and

WHEREAS, it is the purpose of the Council on Dental Therapeutics to improve the status of therapeutics in dentistry by advising the dental profession and public concerning the value and usefulness of proprietary remedies, on the basis of acceptable scientific evidence, and to promote the teaching and research of pharmacology and therapeutics by approved, objective, scientific methods in dental institutions; and

WHEREAS, the Council on Dental Therapeutics are publishing reports on proprietary products in the JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, and because of the increasing demand for these reports by the profession; and

WHEREAS, the Council has in preparation a small volume containing the reports of the acceptable and useful remedies with short descriptions of their properties and action and doses, to be known by the title "Accepted Dental Remedies"; now therefore be it

Resolved, that the American Association of Dental Schools again wishes to express its appreciation to the American Dental Association in initiating this splendid work in safeguarding the interests of the public and the dental profession and go on record endorsing the excellent work of the Council on Dental Therapeutics, and be it further

Resolved, that the American Association of Dental Schools respectfully requests the American Dental Association to proceed to an early publication of the book entitled "Accepted Dental Remedies" by the Council, so as to be available and put to use by the members of the dental profession.

During the past year, the Council has continued its function, namely, the protection of the dental profession and the public against fraud or imposition, undesirable secrecy and objectionable advertising in connection with the marketing of proprietary dental articles.

The results of the Council's deliberations are published in THE JOURNAL. It is the plan to publish all of its actions for the guidance of the profession, since the Council is interested in the reports only as they may be useful to the profession.

The number and tenor of the reports published depend on the articulate demand for them. Those articles which comply with the rules of the Council are accepted for its list, Accepted Dental Remedies, and those which do not comply form the basis of a report, giving the reasons for nonacceptance.

Many dentists have availed themselves of the opportunity for obtaining information not only on proprietary products but also on chemical matters of dental interest.

The following articles were announced as acceptable during the course of the year: Iodent Tooth Paste, No. 1 and No. 2; Hyclorite; Parke, Davis & Co's Viosterol in Oil, 250 D; Parke, Davis & Co's Cod Liver Oil with Viosterol 10 D; Ampoules Ammoniacal Silver Nitrate-Condit; Calglucon; Sodium Perborate, Flavored, Merck; Naboc Tooth Powder; Pebeco Tooth Paste; Squibb Dental Cream; Maltine with Cod Liver Oil; Procaine Solution—Anestubes; Procaine-Epinephrine Billets-Novol; Procaine Epinephrine Solution-Anestubes; Silver Nitrate Applicators; Alphanaphthol; Alpha-Naph-Co Dental Cream; Calglucon Effervescent Tablets; Thromboplastin Local-Squibb; Fibrogen Local-Merrell; Viosterol in Oil, 250 D-Squibb; Squibb's Cod Liver Oil with Viosterol 10 D; Squibb's Cod Liver Oil with Viosterol 10 D, Mint Flavored; Neo-Silvol; Silvol; Plough's Tooth Paste; Trichlorethylene-Calco; Procaine Tablets No. 4 (Novol); Procaine-Epinephrine Tablets (Novol); Procaine-Epinephrine Tablets, No. 1, No. 2, No. 5, No. 6, No. 10, No. 12; Pyridium; Aqueous Solution of Pyridium; Pyridium Ointment; Pyridium Tablets.

The following articles during the course of the year were declared not acceptable or were the subject of reports from the A.D.A. Bureau of Chemistry: Somnoform; Mico Pyorrhea Solutions; Dr. Bell's Guaranteed Pyorrhea Remedy; Kolynos Dental Cream; Dr. Hand's Teething Lotion; Dr. Hubbel's Formula; Campho-Phenique; Calsodent; Sedormid; Dentinol; Pyrozide; Sodibor; Kramer's Original Charcoal Dental Cream; Dr. McArthur's Dental Massage and Ora Hygiene; Neu-Ora Contact Anesthetic; BiSoDoL.

In addition to these, a number of abstracts of Notices of Judgment from the U. S. Department of Agriculture declaring articles of dental interest misbranded because of false and fraudulent therapeutic claims were published in THE JOURNAL because of the bearing of the work of that branch of the Government on the work of the profession. The dentist and his patients were thus informed of the activities of this department.

In this place, it is pertinent to mention that the activities of the Food and Drug Administration of the Department of Agriculture of the National Government in the field of dental cosmetics and dental nostrums within the last three years should be a source of gratification to many members of the dental profession. It is possibly more than a coincidence that the federal authorities should have turned their attention to this type of products only about twenty-two years after the passage of the Food and Drugs Act. It is not hard to find a reason for this, since the federal authorities must naturally be guided by what might be considered competent professional opinion.

Paradoxical as it may seem, organized expression of competent professional opinion on the marketing of such preparations to the public was generally lacking

until the work of the Council was started. It may be assumed that the entrance of the American Dental Association through the Council on Dental Therapeutics into this work has stimulated the interest of the governmental authorities. Much good work can come from this source, and it is hoped that when Government agents in different parts of the country call on members of the dental profession for expert testimony in connection with legal action on certain dental nostrums, the members of the profession will lend every aid possible to the governmental authorities. The Council cooperated with the Food and Drug Administration and the Federal Trade Commission, as well as local and national better business bureaus.

ARTICLES ON PHARMACOLOGY AND THERAPEUTICS

The Council holds that the rational practice of therapeutics in the last analysis is a correlated application of information in the basic sciences to the treatment of diseases by medical or surgical procedures. It has therefore attempted during the last year, as previously, to publish articles of a general nature on pharmacology and therapeutics. During the course of the year, the following articles have been published:

"Absorption of Drugs from the Teeth"
"Glycerin in Tooth Pastes"
"Dental Significance of Fluorid in Dietary and Therapeutic Products"
"Fibrin Ferments and Thromboplastic Substances"
"Stock Solutions and Mixtures for Local Anesthesia"
"Mouth Washes"

Several of these articles were contributed by scientists and dentists who are not members of the Council, and to these the Council expresses its appreciation.

ACCEPTED DENTAL REMEDIES

The resolution of the American Association of Dental Schools calls on the American Dental Association to make available the small book "Accepted Dental Remedies," which the Council has had in mind since its inception. The manuscript is practically ready, and can be completed for the printers in a reasonably short time, but further active preparation has been withheld because no funds are available for the publication. At its last meeting, the Council discussed possible ways and means of bringing the book into actual being. It was suggested by a member of the Council that the book be underwritten as a project of the members of the Council, and that when the amount for underwriting was received, any profits and the copyrighted manuscript be turned over to the American Dental Association. It is, the consensus of opinion that such a measure would not be desirable, because if the book is to fill a real need, the request for it must be great enough to come directly from the profession.

Many articles of a proprietary nature of dental-medical interest are tentatively accepted in the manuscript, but publication has been withheld for various reasons.

The reports published in the Council section of THE JOURNAL represent a small number of those available for publication. Owing to lack of space, a choice must be made as to the articles published.

The action of the American Association of Dental Schools is a general expression

of the many inquiries that have been coming to the office of the Council concerning the publication of A.D.R. The work of the Council in reality will not be in full swing until this list of acceptable dental remedies is made available because the members of the Council, in discussing proprietary products, take the position that the dental readers of its reports are acquainted with the fundamentals of materia medica, pharmacology and therapeutics and have at their command information on the official drugs. The underlying thought is that, with very few exceptions, all the drugs needed for intelligent practice are listed in the U. S. Pharmacopeia or the National Formulary.

From time to time, members of the profession have expressed a desire for reprints of the reports already published by the A.D.A. Bureau of Chemistry and the Council. The executive of the Council and the Bureau has consistently adhered to the practice of sending these reprints to members of the profession without charge. It has been suggested by correspondents that the reprints be collected between covers and sold for a nominal sum. This could be accomplished if enough members of the profession were to guarantee such a project. The advantage of such a project is readily apparent, for the articles published to a certain date would be readily available and they would be in a handy volume, which dentists could show to their patients, thus aiding in the work supported by their national organization.

DENTIFRICES

In discussing the dentrifice situation, the Council offers an explanation. It is apparent from the published reports that the Council has given much attention to this problem. The amount of attention given the subject is not a measure of its importance, but the attitude taken by the Council has rather become necessary because of the pressure of advertising claims made in the public newspapers and from requests for information from dentists and other persons. The Council feels that the dentrifice situation has improved, but it is far from satisfactory. Until every advertiser of a dental product limits his statements to that which can reasonably be expected—that it is an aid in cleaning the surfaces of the teeth—there will be room for criticism of this type of business on the part of the Council.

Relatively speaking, the situation is much better than before the formation of the Council. It should be a source of gratification to the members of the profession interested in honest advertising of dentifrices to note the rather pleasing advertising of those whose products have been accepted by the Council. In view of the great similarity of the composition of dentifrices, the members of the dental profession can help in this work of reforming tooth paste advertising by advising their patients to use those products which bear the seal of acceptance of the Council. Manufacturers who advertise honestly, and thus place themselves above the tactics of some members of their trade, should be encouraged by more than words. Encouragement of these advertisers will make it evident to those who do not conform to the liberal and simple rules of the Council for dentifrices that they must change their tactics, for, in the last analysis, advertisers gage their progress by the financial sheet.

The absence of reliable data as to the relative cleansing or abrasive character of dentifrices is well known. During the past year, some start has been made toward placing on record information of this sort by manufacturers of insoluble materials

used in dentifrices. These manufacturers have consulted with the full-time officer of the Council, and where evidence of an honest endeavor was apparent, every encouragement toward cooperation was offered. It may be premature to mention that steps are under way to encourage these manufacturers to carry out a cooperative referee plan to examine these products on a scientific basis. It must be appreciated that commercial consideration may seriously retard this accomplishment. It is hoped that enough manufacturers will agree to carry on this cooperative investigation. Results, of course, cannot be expected overnight, but if the investigation is once undertaken, by a trained personnel, and the results are made available for inspection, it is apparent that progress will be made away from the situation in the past, when no such information was available. If such information is made available, the dentists will have a basis on which to answer the question: "Doctor, what dentifrice shall I use?"

The Council has continued its liberal policy with dentifrices. It has in the course of the year, made some decisions which it is hoped will help to better the dentifrice situation, which is a story by itself. It is readily apparent to many dentists that little capital is required to launch a dentifrice on the market. Many are put out by dentists; many by those whose acquaintance with dentistry reaches no farther than an advertising office. It is discouraging at times to note that many dentifrices put out by men with the dental degree have been found to conflict with the Food and Drugs Act.

Although a report has not been published, the Council has taken the position that, for dentifrices put on the market after the formation of the Council, one of the conditions of acceptance would be that the product be named "So-and-So's Tooth Powder" or "So-and-So's Tooth Paste." This action was intended to do away with the many misleading trade names for dentifrices. The Council could accept under no conditions a dentifrice the name of which bears the prefix "doctor" or the suffix "D.D.S." or "dentist" as part of the designation.

The reason for this is not hard to see when one reviews the dentifrice situation of the past; nor would it be in keeping with the best ethics of the profession to accept such a designation. It is inconceivable how a dentist, for example, in Los Angeles, can presume on the basis of the knowledge available at the present time to make a dentifrice that would fit the mouths of those, for example, in New York. If the doctor is to play any part, the tooth paste or tooth powder should be prescribed on an individual basis, and only after examination of the individual mouth. Otherwise, the designation "Dr." or "D.D.S." as part of the name is a farce. To condone such a practice is in effect to condone the whole system of "patent" medicines—that of prescribing medicine (although it may be granted that a dentifrice occupies the position of a cosmetic) from a factory. It must be appreciated, again, that although several dentifrices bear the name "Dr. So-and-So's Dentifrice," in many cases they do not represent the product of professional skill, but rather the activity of someone other than a dentist or, in many cases, of advertisers.

Because of the potential abrasive properties of silica, the Council cannot, under any conditions, accept a dentifrice containing this substance until concrete evidence is given that continued daily use of these agents alone or in a dentifrice does not harm the enamel, cementum or dentin.

The Council is open-minded on the question of tricalcium phosphate in a tooth paste. To date, it has not accepted any dentifrice containing tricalcium phosphate because of information that a dentifrice which was said for a number of years to contain tricalcium phosphate was known to be abrasive. By adopting this position, the referee in charge of these tooth pastes hopes that those interested in the making of products of this class will furnish the required information. The burden of proof must no longer be placed on the profession and the public, but on those who are marketing the products.

ABSTRACTS

The Secretary of the Council has continued to abstract the reports of the Council and the Bureau of Chemistry and send them to the editors of state and component societies for publication.

THE BUDGET OF THE COUNCIL

The last year has been very trying for the Council as far as its budget requirements were concerned.

To pass over the question of salaries: The effect of insufficient funds on the actual work of the Council is apparent to those who are fully occupied with its affairs. The Bureau of Chemistry for some time has had definite information that the procain supply marketed to dentists by one particular manufacturer was not of the stated amount. It was felt desirable to purchase samples of all brands of procain and assay them for the procain content and for epinephrin, but this project had to be set aside and possibly abandoned.

ACKNOWLEDGMENTS

As in the past, members of the dental and allied professions have readily responded to requests of the Council for aid. Floyd DeEds, senior toxicologist, U. S. Department of Agriculture, prepared the article on "Dental Significance of Fluorid in Dietary and Therapeutic Products," and Charles W. Freeman, professor of oral surgery at Northwestern University Dental School, and the Research Council of the New York Academy of Dentistry rendered valuable aid and advice on products considered by the Council.

BUREAU OF PUBLIC RELATIONS

THE STATUS OF THE DENTAL HYGIENIST IN THE FIELD OF DENTAL HEALTH SERVICE*

By A. R. McDOWELL, D.D.S., San Francisco, Calif.

THE dental hygienist movement is of comparatively recent growth in the United States, it being only seventeen years ago that the State of Connecticut first licensed the hygienist (1915) and defined her field of practice. During the intervening time, dental health service has enjoyed one of the greatest periods of advancement in its history. The value of oral health and its relation to systemic conditions, too, has grown in interest so that it has come to be more and more of public concern and is now looked on as an indispensable part of a modern public health program.

In fact, public health, the field in which you are engaged, is and should be the concern of everyone. We are living in a day —an age—of great interest in health and health education is found correlated with many other subjects in the public schools. There is hardly a school room in which there is not an evidence of constant attention being given to health habits. You will find health posters, diet lists, honor rolls for good teeth and many other indications of interest in health problems in almost every school building today. Inspection of the teeth of the preschool child and drives for the care of children's teeth are being carried on by the dental profession, and hygienists often lend valuable assistance to these progressive movements. Much interest is manifested in health games and health messages are dramatized, as in the "Sells' Health-O-Circus," "Bobby's Bad Molar," and many other plays and moving pictures. These health dramatics convey messages to the children in a most impressive manner. During the 1931 meeting of the California State Dental Association, in San Francisco, an evening program open to the public was presented in the auditorium of the High School of Commerce with speakers on public health topics. A feature of the evening was the "Sells' Health-O Circus," in which more than 100 children participated on the stage before an audience of about 1,500 parents, teachers and others interested in the subject. The following morning, it was again staged for the children of both the public and the parochial schools. This playlet was staged under the direction of Miss Anita C. Junck, dental hygienist in the San Francisco schools, and the interest this presentation aroused resulted in the presentation of the playlet in several other cities of the state. Do you not

*Read before the Dental Hygienists' Section at the Third Triennial Session of the Pacific Coast Dental Conference, Seattle, Wash., July 8, 1932.

agree that the educational benefits resulting from this type of performance are many?

Every community presents a similar opportunity for the dental hygienist to develop educational health programs, and with the radio, newspapers, movies, etc., carrying such messages into the homes, we are fast becoming more and more interested in matters of health.

I compliment you on your educational opportunity in the field of public health and on the growth the American Dental Hygienists' Association has enjoyed since its organization in 1923. From a class of twenty-seven hygienists graduated in 1914, it is estimated there are about 2,000 graduate dental hygienists at the present time.

A GLIMPSE INTO THE PAST

In order that we may get a relative understanding of the dental hygienist's status in the field of dental health service, let us make some excursions into dental history and review in part some of the literature.

Nothing in this world "just happens." The dental hygienist's position is not merely a "happening"—quite the contrary. She has come into the field of public health as the result of training for a special type of oral health service as an assistant to the dentist, in order that the dental profession may more adequately cope with the great problem of preventive dentistry. Prior to the advent of the dental hygienist into the dental field came the woman office assistant, whose status we might consider in order that we may better understand the relationship of the one to the other.

Tradition informs us, and this in turn becomes accepted history, that the forerunner of the lady office assistant was the "office boy." We find, if we go back fifty years and even much earlier, the office boy was commonly employed in the law, medical, and dental offices as an assistant to run errands and help in the various duties of the office. It was then, too, quite the general custom that the assistant was retained on a very small salary in return for the opportunity of learning the profession, and during this period of professional development such terms as *reading law, studying medicine,* and *apprenticed in dentistry* were coined under our early preceptorial system of education.

The preceptorial system of education gradually gave way to the demands for a better and more thorough training. From this public demand college educations for the professions supplanted the apprentice method of training, and the office boy assistants slowly disappeared with the changes of time. The dental profession shared with all forms of education in this evolution, and dentistry, figuratively speaking, "having gone to college," took on a new dignity and entered a new era of its growth. With the enlarged opportunities came greater and more exacting responsibilities in dental practice, and in equipping to meet them the dental profession again sought assistance, this time enlisting the services of the lady assistant who, on first appearance, came as an untrained maid, servant, or "office girl."[1]

The idea of woman assistants in dental offices received much unfavorable comment at first from the public and members of the dental profession, just as opposition had been registered years before to women entering the profession of dentistry. Lucy B. Hobbs, the first woman graduated from a dental college, Feb. 29, 1866, and others have written of their many and varied embarrassments and humiliations on entering dental practice. This antedates many years the present emancipation of women in the world's work, though it seems that tradition and custom "die hard," as, even today, many of our dental colleges do not admit women to the study of dentistry.

It took a great deal of courage for a young woman to enter the study of den-

1. McDowell, A. R.: D. Cosmos., 73:184 (Feb.) 1931.

tistry or to become a dental assistant and face the storm of unjust criticism leveled at her in the pioneer days of woman's entry to these respective fields.

The trained nurse in the medical world also was met with decided disfavor at first. We find, as time went on, women in the field of public health, through their tact, personality, and efficiency, steadily gained favor, and they have proved their worth to the extent that today there are approximately 2,000 women dentists, 2,000 dental hygienists, 12,000 dental assistants and 200,000 trained nurses in the service.

The dental hygienist, on her appearance, was spared the earlier prejudice against her sex to a large degree through the efforts of those women who had gone before and blazed the trail for woman's entry in the field of dental health service.

THE ADVENT OF THE HYGIENIST

Though the dental hygienist movement is of comparatively recent origin, by a long stretch of evolutionary processes, her training had its origin a long, long way back in dental history, ultimately leading up to the oral hygiene movement, so well known to dentistry of the present day.

We learn in Taylor's "History of Dentistry"[2] that "dentistry in some of its cruder forms must have come into being as soon as man began to experience trouble with his teeth." We have to accept this broad interpretation of the origin of dentistry; and even though the Assyrians, Chaldeans, Romans, Grecians, Egyptians and Chinese boast a very ancient civilization, dating back several thousand years before Christ, and even though their hieroglyphic writings have been found to deal with dentistry, as, for instance, the Papyrus of Ebers, which dates from 3500 to 1500 B. C. and gives many remedies for toothache, the first mention of any form of dental practice resembling oral hygiene as we understand it today dates from the Middle Ages. Abulcasis (1050-1122), an Arabian author, who lived at Cordova, was one of the most able writers and surgeons of the Middle Ages. He was especially interested at that early date in prophylaxis and devoted special attention to the tartar on the teeth, illustrating and describing fourteen forms of scrapers or scalers for its removal.

Continuing on through the years, the next thing we uncover suggestive of preventive dentistry was written by Pierre Fauchard, the founder of modern dentistry. Fauchard was born in Brittany about 1690 and died at Paris in 1761. He published a work in 1728 entitled "Le Chirurgien Dentiste," consisting of two volumes with forty full-page plates, 863 pages in all, and treating of all branches of dentistry as understood and practiced at that time. In the second edition of Fauchard's work, which appeared in 1746, appears the first account of pyorrhea alveolaris (pp. 275-277).

Then, in the American colonies, in reviewing the account of some of the pioneer American dentists, we find Josiah Flagg announcing his dental practice at No. 47, Newbury Street, Boston, in 1796, where, he states, "may be had dentifrices, tinctures, teeth and gum brushes, mastics, etc., warranted approved and adapted to the various ages and circumstances; — also chew-sticks particularly useful in cleansing the fore teeth and preserving a natural and beautiful whiteness." About the same time, John Greenwood (who was Gen. George Washington's dentist later) also located in Boston and announced in the *Boston*

2. Taylor, J. A.: History of Dentistry, Philadelphia: Lea & Febiger, 1922, pp. 21, 34, 50, 58, 72, 75, 96.

Daily Advertiser, Feb. 28, 1786, as follows: "John Greenwood, dentist, No. 199 Water Street, Encouraged by the success of his practice, begs leave to acquaint the publick that he preserves the Teeth and Gums by removing an infectious tartar, etc."

Dentists were becoming more numerous with the passing of the years and dentistry was coming to be more generally practiced. Passing on to the nineteenth century, we find dentists vigorously carrying on campaigns of education regarding the importance of the teeth and their care. Itinerant dentists were condemned and people were urged to patronize resident dentists who were known to be more reliable. "Dr. John M. Riggs, born at Seymore, Conn., Oct. 25, 1811, deserves mention as the first American dentist to describe suppurative inflammation of the gums (so often called Riggs' disease) and to prescribe a correct treatment by removing the tartar or deposits found on the necks and roots of the teeth," according to Taylor in his "History of Dentistry." Continuing, he states, "Dr. Riggs is called the discoverer of this treatment, but he cannot be said to have been the first to describe the disease, as Fauchard did the same in 1746."

From these sketchy accounts, we can appreciate how the dental profession slowly but gradually through the years came to recognize the value of oral hygiene.

We are perhaps inclined to think of oral hygiene as a product of the twentieth century because of the dental profession's paying so much attention to it of late years; when actually we are now perhaps only arriving at a state of affairs visualized by Fauchard, Flagg, Riggs and others over a hundred years ago. It is true that the conception of oral hygiene in their time was not the one held at present. As time went on methods of caring for the teeth advanced, and, in 1898, D. D. Smith, of Philadelphia, demonstrated a definite technic of prophylaxis whereby scaling and polishing the teeth, diseases of the soft tissues and dental caries could be prevented.

In 1899, inspired by these demonstrations of the great advantages of dental prophylaxis, Alfred C. Fones,[3] of Bridgeport, Conn., further evolved a system of instrumentation and polishing of the teeth for that purpose, which he used until 1905. Dr. Fones believed that the prophylactic procedures, which are simple in technic but require considerable time, might be entrusted to an assistant, so that the dentist's attention could be devoted wholly to more difficult service. He therefore taught the technic, as you well know, to his office assistant, Mrs. Irene Newman, who thus became the first dental hygienist. Seeing the benefit which his own patients were receiving suggested to Dr. Fones the desirability of oral health service for the children in the Bridgeport public schools and, after four years of effort, he finally, in 1913, succeeded in securing sufficient funds to finance the plan.

The next problem, after the money was secured, was the training of a sufficient number of dental hygienists to carry out the proposed prophylactic treatment of the children in the schools. In order to meet this demand, Dr. Fones, on Nov. 17, 1913, with the aid of eighteen distinguished teachers of biologic or medical sciences and practitioners of dentistry or medicine, began, in his office, the building of the first training school for dental hygienists. There were

3. Bulletin 19, Carnegie Foundation for the Advancement of Teaching, pp. 74-75.

thirty-three young woman in the class and, June 5, 1914, twenty-seven were graduated as dental hygienists. Therefore, the dental profession, again and for the third time, in equipping to meet its enlarged opportunities and greater responsibilities, sought assistance, this time through the training of the dental hygienist, as an auxiliary service in the field of preventive dentistry.

SCHOOLS FOR DENTAL HYGIENISTS[4]

There are now sixteen schools in the United States that offer courses for dental hygienists. These schools are listed as follows, in the order and date of their opening:

1. Columbia University, New York City 1916
2. Forsyth—Tuft's Dental Dispensary, Boston, Mass.....1917
3. Rochester Dental Dispensary, Rochester, N. Y.....1918
4. University of California, San Francisco, Calif.....1918
5. University of Michigan, Ann Arbor, Mich.....1922
6. University of Minnesota, Minneapolis, Minn.....1922
7. University of Pennsylvania, Philadelphia, Pa. 1922
8. Temple University, Philadelphia, Pa. 1922
9. Northwestern University, Chicago, Ill.....1923
10. Marquette University, Milwaukee, Wis.....1924
11. University of Tennessee, Memphis, Tenn.....1925
12. North Pacific College of Oregon, Portland, Ore.....1925
13. Atlanta School of Oral Hygiene, Atlanta, Ga. 1929
14. University of Southern California, Los Angeles, Calif.....1929
15. Georgetown University, Washington, D. C. 1929
16. Kansas City-Western Dental College, Kansas City, Mo. 1929

All of these courses, lead to the certificate of dental hygienist, four of them are two academic years in length, while the twelve other schools maintain one year courses.

STATES THAT LICENSE THE HYGIENIST

Connecticut was the first state to license the dental hygienist, in 1915 and now (1932), seventeen years later, twenty-nine states, the District of Columbia and Hawaii, as follows (in alphabetical order) have licensing laws:

Alabama	Minnesota
Arkansas	Mississippi
California	New Hampshire
Colorado	New York
Connecticut	North Carolina
Delaware	Ohio
Dist. of Columbia	Oklahoma
Florida	Pennsylvania
Georgia	Rhode Island
Hawaii	South Carolina
Iowa	Tennessee
Louisiana	Vermont
Maine	Washington
Massachusetts	West Virginia
Michigan	Wisconsin

Wyoming

THE DENTAL HYGIENIST ABROAD[5]

Outside our own country, in New Zealand and Australia, we find the government training dental hygienists, or dental nurses, to work for the children in the schools. The course is two years, there is no tuition, and the graduate is pledged to remain three years in the employ of the government after graduation.

In Hawaii, they had a two-year course for hygienists, at the Teachers' College, which, I understand, has been temporarily discontinued. In Sweden, dental

4. Since the presentation of this paper, an additional school has been started at the Murry and Leonie Guggenheim Dental Clinic in New York City.

5. Schmidt, Evelyn C.: Dental Hygienist: Here and There, J. A. D. A., 16:1694 (Sept.) 1929.

hygienists have been trained at the request of the government. Canada has a course for dental nurses at the Royal College of Dental Surgery, University of Toronto. France, Germany, England and Japan also train dental assistants, or dental nurses as they are usually called, but nowhere in any of these countries do they train hygienists.

THE WORK OF THE HYGIENIST

The primary object of the dental hygienist is to teach health, and she is licensed to "remove deposit and stain from the exposed surfaces of the teeth" under the supervision of a licensed dentist. Therefore, the field of the hygienist is of considerable latitude, in that she may operate in the office of a licensed dentist, and in any public or private institution, which includes schools, clinics, hospitals and health centers. Industrial welfare work also opens an extensive field for her services.

Some dentists who have large private practices employ a full-time dental hygienist. The hygienist, in these offices, cleans the teeth of the patients and endeavors to impress on them the value of regular care of the teeth. Because she is doing a special type of work, the hygienist is in a position to teach oral health and instruct the patients as to how to brush the teeth properly and how to take care of the toothbrush. If there isn't work enough to keep her busy at the chair all the time, the hygienist may act as an assistant to the dentist in his work; perform secretarial duties; make appointments; answer the telephone, and employ her time in many other and varied useful pursuits necessary to the conduct of a successful practice.

The opportunity for the hygienist in hospitals of various types and in clinics, while presenting a large field, is yet largely undeveloped, and it is probable that a survey of this type of institution would disclose that very few employ a dental hygienist.

At the present time, the public school and health center offers the hygienist her best opportunity by far, for her field of work, and it is in this field of public endeavor that we do find the majority of dental hygienists engaged. In California, nearly half the 100 hygienists licensed are engaged in the public schools.

In the schools, the hygienist enjoys "public appeal" through the children. Here she is a teacher of public health; conducts toothbrush drills, instructs the children in diet and health habits, arranges for essays and songs to be written about the teeth, and addresses teachers and parent-teacher meetings on dental health. Many other duties are included in her field of endeavor. The value of her services in the schools of our country in aiding in the reduction of dental decay and cutting down retardation in the grades is too well known to you for me to do other than pass over them with just this brief mention. Statistics can be cited from cities all over the United States, from both departments of health and boards of education, attesting to the reduction of decay, better attendance and fewer cases of retardation as a result of having a dental program in the schools.

Industrial plants have found that it pays to keep their employes well and healthy, and in the past few years many have developed large health departments, including dental and medical service, for their employes. More and more, the services of dental hygienists are being enlisted for prophylactic work in the industries. In a report on industrial dentistry issued a few years ago, E. L. Pettibone, chairman of the Committee on

Industrial Dentistry of the American Dental Association, listed eighty-nine different corporations maintaining industrial dental clinics wherein dentists and dental hygienists were employed.

The Metropolitan Life Insurance Company,[6] one of the pioneers in the field of industrial health service, has operated a dental clinic for its employes at the home office in New York City since 1915. This company requires all office employes to undergo a dental examination and have their teeth cleaned twice a year. At the home office, the staff consists of a director (Thaddeus P. Hyatt); an assistant director, one full-time dentist, two part-time dentists, fourteen dental hygienists, two x-ray technicians, one assistant x-ray technician, one secretary, four clerks and five sterilizing clerks.

The industries offer a large field for the hygienist, and while a good start has been made, we might say the surface has not yet been scratched. From the standpoint of the number of people who need oral hygiene service at the present time, the hygienist's field is not overcrowded. The field needs to be developed so that greater public demand will be made for her services.

As previously stated, the primary object of the dental hygienist is to teach health—something in which every one is vitally interested and concerned.

Thaddeus P. Hyatt says: "It was because the profession did not clean teeth that the dental hygienist has come into existence."

Alfred C. Fones says:

> I have considered the future of the dental hygienist only in connection with the public schools. . . . Thus it seems that the public schools . . . which reach all the children of all the people, offer the largest contact with the public. It is safer to say that ninety per centum (90) of all constructive health work for the future will be done through this agency.
>
> From this conception of the interdependence of mouth health and general health . . . the field of the dental hygienist must be twofold:
>
> First—There is the . . . prophylactic treatment and instruction in the hygiene of the mouth to aid in prevention of dental caries and gingivitis as far as it is possible, by cleanliness and artificial gum stimulation.
>
> Second—There is educational service concerning these laws of general hygiene which promote the development and growth of a normal healthy body.
>
> It is the work that must eventually influence the coming generation. Only through education can we hope to secure better teeth and a higher degree of immunity to dental disease.

Therefore, the question of the status and need for the dental hygienist includes the principles involved not only in the prevention, alleviation and cure of oral disease but, in addition, in its relationship to general systemic conditions. Prevention of disease remains the largest field for the several divisions of health service. In support of this statement, may I quote from an address entitled "When Does Disease Begin?" by Charles H. Mayo,[7] read before the Minnesota State Medical Association in Minneapolis in May, 1931.

> There is room for more dentists. Just now children are being trained in the care of their teeth. People are discussing for the first time the question of the death of teeth; the conservation of teeth; disease of the jaws; the abscesses that cause no pain because the nerve is dead, a condition that may initiate trouble in any part of the body. They may cause gastric or duodenal ulcers which heal without giving the slightest symptoms, and the scars of which are found at necropsy af-

6. Metropolitan Life Insurance Company, Industrial Dental Service.

7. Mayo, C. H.: When Does Disease Begin? Can This Be Determined by Health Examination? Minnesota Med., 15:40 (Jan.) 1932.

ter death from other causes, or the ulcer may even be active at the time of death without having caused symptoms. The family cannot give a particle of history that will indicate when the patient had symptoms of ulcer. So there must be latent, silent areas in the stomach that are sometimes the site of ulcers which are painless and which cause no reflex symptoms. Bacteria in diseased teeth may also cause renal stones or diseases of the eye. Rosenow has reproduced these conditions experimentally in animals. It is probably true that local sympathetic disturbance may precede and may pave the way for the deposit of the bacteria which have been carried through the blood stream.

It is such messages as this that the dental hygienist can carry to the children in the schools and to the parent-teacher associations, public health nurses, social service workers and allied groups. This is an example of an instructive educational health message for public information and the means whereby the hygienist may further develop her own province and extend the limits of her own domain while doing excellent public service.

A more practical demonstration of dental health can be cited here in Seattle.[8] I refer to the work of the dental clinic at the Cascade School. This clinic, financed by the Kiwanis Club and the Seattle District Dental Society, is just about completing its second year of operation. During the past year, 222 children have been cared for with separate operations totaling 4,122. In addition to the work at the chair, the children are given instruction in brushing and care of the teeth and dental honor rolls are installed in each room. Health talks are also given the children, accompanied each time by the showing of an educational film. Quoting an extract from a letter of appreciation from the Parent-Teachers Association of the Cascade School:

> Scores of children have received attention, and have been made healthier and happier, have unquestionably done better school work, and we trust will grow into a higher and finer type of citizenship as a result of this service.

The Educational Committee, headed by R. I. Vandewall of the Seattle District Dental Society, and the Kiwanis Club are to be congratulated on this excellent piece of dental health work. It is such pioneer work as this that creates a consciousness of the desirability of health in the community. It is such practical demonstrations as this that lead to public demands for a more extended service in more than one school. It would seem to be a forerunner of the dental hygienist's work as a teacher of public health in the public schools of this city.

SOME CONCLUSIONS

What does the future hold for the services of the dental hygienist? An attempt to prognosticate in any line of endeavor is fraught with considerable speculation, but there are a few fundamental facts that we can consider in summarizing.

After being in the field of health service for seventeen years, the hygienist movement has progressed sufficiently for us to have a reasonably true perspective. What do we see in the picture?

We see the work of the 2,000 hygienists under supervision of the licensed dentist as a most valuable aid to the dental profession in the field of preventive dentistry. The dental hygienist is serving with satisfaction in those private practices that are sufficiently large to require her services.

We see her excellent work in the public schools, both at the chair doing

8. Vandewall, R. I.: Personal communication to author.

prophylactic service and as a teacher of public health in the classroom. We see the 30,000,000 to 40,000,000 children in the schools of the United States needing her dental care and health protection, and, at present, perhaps only 30 to 40 per cent of them receiving any dental attention.

We see sixteen accredited training schools for hygienists and twenty-nine states of the Union, District of Columbia and Hawaii licensing her services. We see the hygienist in the light of her feminine characteristics, possessed of high ideals, with poise, tact, personality, initiative and individuality, carrying out the directions of the dentist under whose supervision she works, and therein we see mirrored the type and character of her work, so much so that it can be generally stated that the hygienist's ideals are commensurate with those of the dentist who directs her activities.

We see some unfavorable situations in the picture that have a tendency to make the hygienist's progress slow and a little more difficult.

On examination of the courses in the training schools for hygienists, there is disclosed a wide variation. Four of the courses are two academic years in length and twelve are for only one academic year, which bespeaks a wide difference in curriculum content. This serious lack of uniformity impedes progress through dissension prompted in your own and in the ranks of the dental profession. It prevents the hygienist from taking the licensing examination in many states, and causes disparagement in the field of training.

The state laws, too, licensing the dental hygienist vary in many important particulars. In some, the preliminary educational requirements vary from "none stated at all" to the requirement of "a diploma from an accredited high school" or a "four year high school or its equivalent."

Some of the licensing laws give the state board authority to revoke a hygienist's license "for cause" and other state laws do not even mention it. Thirteen states provide for reciprocity and the others do not. The ages specified for the licensing examinations vary from 18 to 21.

A hindrance to the hygienist movement in the field where she seems most useful, that of the public schools, is found in the complaint of teachers in the public schools regarding the disparity existing between the training, length of training requirements for certification, hours and salary of the dental hygienist and their own. This situation becomes controversial in many localities and creates unpleasantness, prevents cooperation and produces a lack of harmony inimical to the interest of the children and the dental hygienist movement.

These are, briefly, some of the favorable and unfavorable situations that are present today in the dental hygienist's field of endeavor.

And, finally, let us again ask, what does the future hold for the service of the dental hygienist?

May I answer this by saying that it is time for those charged with the training of dental hygienists, all who are interested in public health work, all interested members of the dental profession, and the dental hygienists themselves to strengthen the favorable aspects and unite at the same time in the elimination of the unfavorable aspects involved in the problem of your life work?

Life is at best a series of changing events, and certainly it is so in the evolution of a profession. The future for the services of the dental hygienist must

necessarily rise or fall with the public and dental profession's need for her services. Also there are some underlying factors involved in the satisfactory solution of this question. Two vital issues invite our serious consideration in this respect:

1. Viewed from the standpoint of world affairs, this issue is one of economics and the law of supply and demand. It involves finance when an increased demand is created on our boards of education, health departments or supervisors —a step toward a paternalistic form of government—and we as a nation are today crying out to our local, state and federal governments to lower the cost of government.

2. Viewed from the standpoint of health service, the future of the dental hygienist is involved with all other divisions of public health agencies in the present-day controversy regarding "state medicine and dentistry," "panel dentistry," "socialization of dentistry," "insurance dentistry" and other similar forms of public supported systems now so generally discussed.

It is hard to predict the future of the dental hygienist movement, but it seems reasonable to accept the conclusions of Miss Alice H. Cotton, supervisor of child welfare and attendance in the San Francisco school department:

> *If* the various school departments continue to be conscious of the need for dental education in the schools, *if* industry decides to continue to add dental care to the rapidly growing list of services it already offers its employes, *if* private dentists continue to realize more keenly that dental hygienists are a real asset in their practices, more and more hygienists will be needed to fill the various positions and the services of the dental hygienist will continue to grow in demand.

EARLY ROENTGEN-RAY DIAGNOSIS OF DENTAL CONDITIONS IN YOUNG CHILDREN *

By LEO J. SCHOENY, D.D.S., New Orleans, La.

IT is the aim of this paper to promote interest in children's dentistry as a whole with special emphasis on the routine full mouth roentgen-ray examination and diagnosis of our very young patients.

I do not expect to disclose any startling facts or to even tell you anything which you probably do not already know; but it is my hope to set some of these facts before you in such a manner that you may see them in a new light and perhaps be more impressed with their importance and value in the scheme of preventive dentistry. Nothing, in my opinion, can be of greater value to the dentist in his study of a child's dental condition, provided he is conscientious in his efforts to lay a foundation for the prevention of disease and disorder, than a full set of dental roentgenograms, taken with films especially designed for use in a child's mouth and according to some standardized technic. Of course, we must acknowledge the importance of calcium and phosphorus metabolism, and proper diet, in this connection, for these problems concern the health of the teeth as well as the general health of the patient. These problems of physiology and biochemistry would make another story and a complete one by themselves.

It has been said and, I believe, generally accepted by our profession that one solution of dentistry's economic problems lies in the early recognition of dental defects and disorders. With a full mouth set of child size roentgenograms (fourteen films constitute a full set), we can make a thorough study of the case and, knowing what is normal, be able to recognize any condition which may tend to vary even though but slightly from the normal or healthy. With this picture before us, we can outline and institute the necessary corrective measures and usually prevent further development of the defect or disorder. By this timely intervention, we not only shall contribute toward the prevention of dental disease, but also shall unquestionably contribute largely toward the prevention of general systemic disease and disorder, the actual cause of which is frequently never traced to a dental origin, as, for instance, conditions resulting from lack of sinus development.

It is possible that the routine roentgen-ray examination and diagnosis, with films that fit the child's mouth and meet all other requirements, may result in the discovery of defects or disorders of which we have no knowledge at this time. Such was the case when roentgenography was first employed in dentistry. Why should we not hope to uncover unknown conditions (if any exist, and I believe we all agree there is much yet to be learned), if we are successful in obtaining dental

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 21, 1931.

roentgenograms of our child patients which are clear in detail and without distortion; in other words, of actual diagnostic value?

This, of course, has been possible to some extent in the past, if one only took the time and trouble to trim down a lightning speed standard size film to about half size and rewrap the packet. I have resorted to this practice for years and, though the packet was crude and bulky, obtained very fair results. But as all this took time, and occasionally the film was ruined during the procedure, we could scarcely expect a great number of dentists to follow this procedure. Some tell me that they have obtained very satisfactory results by simply folding the standard size film in half. This may be: I have repeatedly tried it and was never thoroughly satisfied with the result in a single case. In fact, I must admit that our roentgenography in the case of small children has in the past been far from what could be desired, and consequently many little patients have suffered for want of a thorough and complete roentgen-ray examination and diagnosis.

Feeling keenly this need of a film particularly designed for use in a small child's mouth, and believing its availability in our supply houses would result in its general use by our profession, I took up the matter with one of the large x-ray manufacturers. On being convinced of its value to the profession and the public, and the important rôle it could play in the preventive field, this company immediately took action and, in a very short period, placed a suitable film on the market.

The extra-oral and the occlusal films have a definite place in roentgenography in children's dentistry and have given us very satisfactory results. The standard (adult) size film has also given us fair results in some exceptional cases, particularly in large children, when lightning speed was not so important and when the mouth would accommodate a large film.

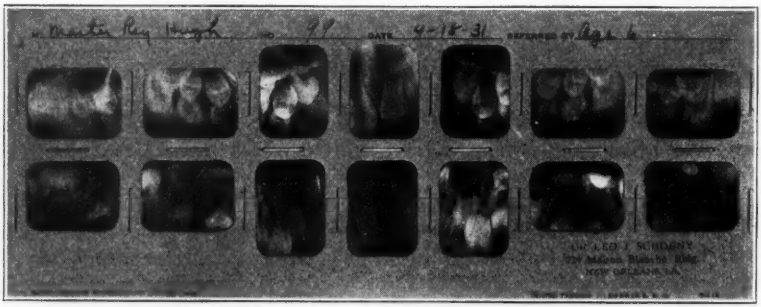

Fig. 1.—Case of boy, aged 6 years. There is a well-advanced carious area on the distal surface of the lower right deciduous first molar which was not evident in the clinical examination.

I have mentioned the possibility of discovering unknown conditions with routine roentgen-ray examinations in children's dentistry with films suitable for the purpose; but we really need not hold out to the profession the hope of discovering something new as a reason for advocating the full mouth roentgen-ray examination and diagnosis, for there are enough pathologic conditions already

known to science which are preventable by timely interference.

Let us consider some of our orthodontic cases, for instance. We must admit that many such cases, resulting from lack of care of the deciduous teeth, or the first permanent molars, or from the presence of supernumerary teeth or congenital absence of permanent teeth could have been prevented by the dentist if he had recognized the exact condition early enough and had been able and willing to render the treatment indicated in the case. I shall emphasize this statement by repeating a remark made by an orthodontist: "Many orthodontia cases are actually created in dental offices." Of course, we all understand what he means, and none of us for a single moment believe that any such conditions are brought about wilfully. We all know that they are the result of ignorance on the part of the dentist in whose hands the child happens to be. It is said that ignorance does not excuse the offender, but, in this case, when we had no ready means of making satisfactory dental roentgenograms of our child patients, many of us could not visualize just what harm would result by not doing this or that, or by doing something else.

Malocclusion is an important etiologic factor in periodontoclasia. Much periodontoclasia can, of course, be prevented by the early recognition and correction of malocclusion by the orthodontist, but would it not be far better to prevent the malocclusion by correcting conditions leading thereto? Malocclusion is also a contributor to dental caries. A large percentage of cases of malocclusion could be prevented by giving proper attention to deciduous teeth and the first permanent molar. The importance of this molar in this connection is recognized by us all. But proper care of the deciduous teeth in an effort to minimize conditions which may lead to their premature loss or lack of function is very important too, because, as we all know, maintenance of their normal function is an important factor in the normal development of the jaws, face, nose and sinuses, all of which are concerned in the general health.

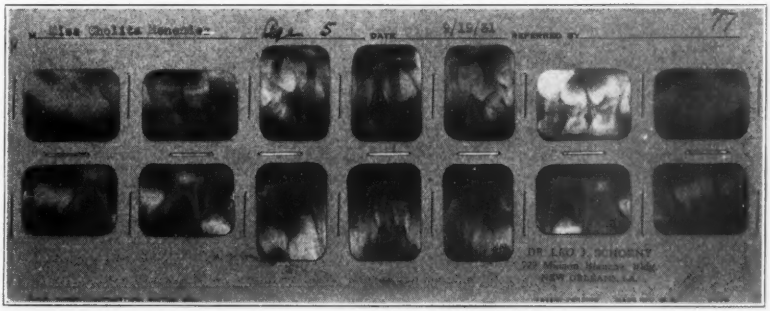

Fig. 2.—Case in girl, aged 5 years. The permanent successor to the lower left deciduous second molar is absent.

The need for retention of the deciduous tooth in its place in the arch until its root has been absorbed and the permanent successor (if one is present) is

ready to erupt and occupy its position should be apparent to us all.

The roentgenogram is our best, and, in many instances only, means of determining the progress of development or the position of the unerupted permanent tooth. It is our only means of determining the congenital absence of permanent teeth or the presence of unerupted supernumerary teeth. It is our only means of noting the exact extent of absorption of deciduous tooth roots or the development of permanent tooth roots, and their relative positions to each other; all of which is sometimes of extreme importance to us, particularly if view, and thereby enables us to prevent pulp involvement. This cannot be stressed too strongly.

Much good can be done for children by our profession if we but have the inclination to do it. It is, of course, a fact that some of us may not possess the ability to get along with children. Unfortunately, child psychology is somewhat different from that of adults, and many of us cannot or will not trouble ourselves to study it. In either case, if we feel we cannot do the very best for the child, rather than do slipshod dentistry it would be far better for us to be honest and refer the patient to some-

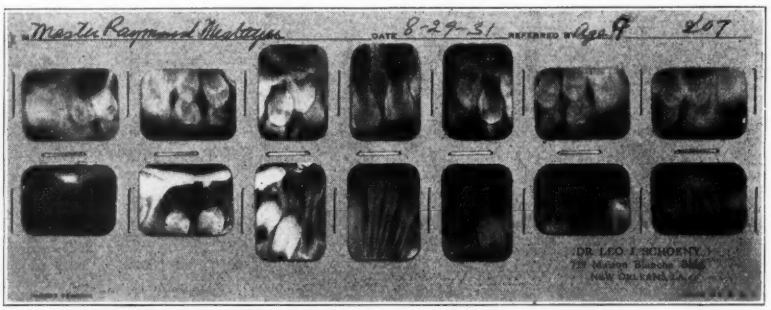

Fig. 3.—Case in boy, aged 9 years, with space retainer in position. There is extrusion and drifting of teeth on the opposite side of the mouth where no retainer was used.

root-canal treatment is considered. It is our only means of discovering evidence and the extent of pathologic processes at root apices or in other areas in the jaw. More and more, dentists are resorting to root-canal therapy as a means of retaining deciduous teeth in the arch as useful organs till they shall be normally lost, and with very satisfactory results. The roentgen-ray examination offers the best means of determining the presence of interproximal cavities or recurrence of caries at cervical margins of approximal restorations, which are otherwise hidden from one who is able and willing to render the highest type of service possible in the case.

After all, children's dentistry is nothing but modern and honest dental principles applied in a common sense manner. The difference, in my opinion, lies in the manner in which we must approach and handle the patient, and in the conditions under which we must operate. From conversations overheard at home and from remarks of larger children, I have learned that visits to the dentist are associated with pain and naturally have developed a fear of the dental

office. Our first problem should be to break down this fear, and inspire confidence and respect instead. If you are but a fair student of child psychology, the first difficulty can be easily overcome; but owing to the small size of the mouth and teeth, the presence of a copious amount of saliva, the restlessness of the patient and the constant moving of the tongue, combined with the usual lack of instruments and materials especially designed for use in a small child's mouth, our work still remains difficult and tedious to some extent. It is for these reasons principally, I believe, that the majority of dentists avoid doing any more than is absolutely necessary for small children, in many instances, actually committing inexcusable violation of their professional obligation by advising the parents that the teeth are only temporary and will be lost in time anyway, and for this reason filling them is really not necessary. Or, when caries has already advanced to the extent of pulp exposure, or when an acute abscess has developed, and the child suffers, the dentist removes the offending tooth or teeth without regard for the damage inflicted and then fails to even advise retention of the space for the succedaneous tooth, which would be so easy with some simple retaining appliance. A full mouth set of roentgenograms of the child patient would surely open the eyes of such a dentist and awaken him to his sense of responsibility.

Taking the profession as a whole, we have failed miserably in prevention all the way through, and all because our appreciation of the harmful results of our neglect has not been sufficiently great to force us to study in order to recognize and correct the defect and disorder in its very incipiency.

I do not mean to blame our profession for actual neglect. I feel rather that our seeming neglect was due to a lack of means of determining many conditions until they had reached an advanced stage. The roentgenogram is our most valuable means of learning of any abnormality or disorder not readily seen in a clinical examination, and while we employ it almost as a routine practice in our adult work, we seldom resort to it with our small patients, except when we feel convinced that some trouble already exists; for the reasons mentioned before, restlessness of the child and the difficulty of keeping the patient and the films in exact position a sufficient length of time to make the exposure. We cannot blame the child—it does not understand, its mouth is small and the tissues are tender, and when we attempt to place a regular size film in correct position, well down or up or distally to include the apical and a part of second molar areas and have the child bite on the biteblock and hold it firm and without moving at all for two seconds or more, he naturally objects. And then, after all this trouble for the operator and pain and discomfort for the child, working it up to a high state of nervousness, making all subsequent work more difficult and perhaps impossible, the film is probably underexposed or distorted and of little diagnostic value. We cannot blame certain dentists for making so few roentgen-ray examinations of their child patients under these circumstances. Fortunately, our troubles in this connection came to an end, with the appearance on the market of the new child's film mentioned earlier in this paper. This film, made particularly for children's work, represents a long step forward in the solution of our problems in dental roentgenography in small children. Its small size and rubber cushion permit its being placed in correct position without

the least pain or discomfort to the patient. Its small size permits its being placed well up or down as the case may be, to extend beyond the root apex area, and in close approximation to the teeth, without bending the film and producing distortion. Its lightning speed enables one to make a complete and satisfactory exposure on even the most restless and fidgety child. If one wishes to obtain the best of results in children's roentgenography, as in adult work, we should have some standardized technic to follow.

When I first became so intensely interested in children's roentgenography. I made an attempt to follow the technic which I use in my adult work. This did not work out so well in the small mouth, but by using it as a basis, and varying from it just 5 degrees, a technic was finally arrived at which gave satisfactory results. To begin with, fourteen films are used for the full-mouth examination just as in adult work. We have fewer teeth on the arches, but the size of the new child film and its relation to the curvatures of the arches are in the same proportion as those found in adult work. If you do not care to secure the area distally to the first permanent molars, a ten-film examination will suffice. In my work, I want this area to show something of the position and stage of development of the second permanent molars. This is one film. Then there is another for the bicuspids, another for the cuspid and lateral incisors and another for the central incisors. This makes seven for each jaw. I do not see how it is possible to make a satisfactory examination of all the teeth and areas requiring study by using less than fourteen films. This fourteen-film technic reveals every tooth, with the exception of the second molars, from two distinct angles, which enables the operator to make a thorough study of the teeth and their investing and surrounding tissues, and to note the presence and extent of any disease or otherwise abnormal condition. Do you realize what a wonderful opportunity this offers us for prevention? Let us all open our eyes to this and make more and better roentgenray examinations of our child patients, thus contributing our full share toward preventive dentistry and medicine.

729 Maison Blanche.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Atypical Facial Neuralgia: Seven cases of atypical neuralgia are reported by David C. Wilson (*J. A. M. A.*, Sept. 3, 1932). Four of the patients had had teeth removed because of pulp stones, three had had injections into the splenopalatine ganglions, and all had had much work performed on the nose and the sinuses. Five had typical atypical neuralgia, one had the migrainous type and one appeared to have an obsession. All except the last had discomfort for many years without relief. All but two now have entire relief and one is improved. Two patients have definitely paranoid personalities. One of these was relieved from neuralgia when her delusion developed; the other was relieved when removed from an irritating domestic situation. Another patient seemed to have a manic-depressive psychosis and was relieved while in a hypomanic state. One patient was relieved by the adjustment of a domestic situation, while another was relieved temporarily by confession of blackmailing eight years previously, when her trouble had first appeared, and experienced some permanent relief when certain foods were removed from her diet and certain dust pollens eliminated from her surroundings. The one patient who showed no change or improvement was relieved for three or four days by the mere injection of procain. From these cases, it is concluded that, in addition to the picture of atypical neuralgia described by the neurosurgeons (pain not referred to the peripheral distribution of the nerve [lips, chin ala of nose] but rather to the cheek, temple, orbit, in front of or behind the ears, and occasionally to the jaws, and not radiating along the course of one or the other nerve tract, but jumping across from one zone of the three divisions to another but never to the periphery, extending beyond the trigeminal territory, behind the ear to the submaxillary region to the shoulder and arm, and characterized by drawing pain, with pressure, or burning, boring or throbbing rather than cutting, stabbing or tearing, deep seated and constant instead of intermittent or paroxysmal), three other characteristics of atypical neuralgia exist: emotional disturbance and change in behavior out of proportion to the symptoms; prevalence in persons of the sensitive, very egotistical and self-centered type, with an underlying feeling of inferiority, and a physical well being seemingly impossible in the presence of such suffering, which suggests the exteriorizing of a painful conflict to the benefit of bodily functions. It is further concluded that some cases of atypical neuralgia are psychogenic in origin. In treating such conditions, psychotherapy should come first. Allergy should be given consideration, but, unless there seems to be involvement of one particular nerve, surgery cannot afford relief unless all cranial nerves are severed. Finally, atypical neuralgia is thought to be due to a sympathetic disturbance in the face, which may arise from many irritants, but especially from intrapsychic conflicts in which there is danger of loss of self-esteem. The pain leaves when the conflict is eliminated.

Nonoperative Treatment of Carbuncles: Report is made by White and Cooney (*New England J. Med.*, Sept. 1, 1932) of treatment of 110 out of more than 500 cases of carbuncle in the Boston City Hospital, during a four-year period, by nonspecific foreign protein therapy, without operative interference. The results of this procedure have been so gratifying that it has come to be regarded as the treatment of choice. The traditionally high mortality attributed to carbuncles of the upper lip has not been evidenced in the authors' series. By protein therapy, they believe that they have fulfilled the requirement enunciated by Light and Sosman: "If a treatment can be found which will shorten the cycle by eliminating or hastening the onset of any of the stages, or which will relieve the pain . . . or one which will effect healing without surgical interference, saving the patient both

operation and later scar, this will be deemed an improvement in the known methods of treatment." The action of the injected protein is manifested clinically by a pronounced feeling of well being. In from two to eight hours, in most cases, pain is markedly diminished or ceases entirely; appetite is increased; sleeplessness is banished, and there is a very definite diminution of toxic symptoms. Coincident with this, there is a moderate leukocytosis and sometimes a slight elevation of temperature. No untoward reaction at the site of injection nor symptoms of protein shock have been observed. The local response is surprisingly rapid, all stages being affected. There is early demarcation of the lesion and abrupt limitation of extension. Intense reddening and tumefaction are followed in a few days by softening, central necrosis and sinus formation. The liquefaction is astonishing, the carbuncle seeming literally to melt away. The liquefied slough is discharged through surprisingly small, cribriform openings, or the openings coalesce, allowing the core to be lifted out *en masse.* Incision is unnecessary. Even granulation and epithelization appear to be hastened owing to general cell excitation. Commercial ampuls of nonspecific protein are used because of their convenience, sterility and uniformity. The one preferred is a germ and toxin free lactalbumin solution made from cow's milk, although two others, one a combination of proteins, lipoids and fats, the other a purified 5 per cent casein in combination with organic iodin, have given satisfactory results. Intramuscular injection is made into the gluteal or deltoid regions. In the authors' series, the largest carbuncles have averaged but four injections. The lesion is treated locally with moist heat as long as inflammation is present, partly because it may help and partly for the psychologic effect on the patient. General supportive and eliminative measures are recommended. Among the advantages of this treatment is the fact that operation and anesthesia are unnecessary, the treatment is ambulatory, constitutional symptoms are quickly eliminated and the scar is minimal, sometimes invisible. The ease and safety of administration recommend this technic to the physician.

The Arrest of Dental Caries: Evidence has been submitted previously to indicate that dental decay can be arrested or prevented by diet. Subsequent studies have confirmed these observations, as have the published reports of other investigators. The establishment of arrest has been followed progressively in children under dietary control; the groups studied included children with active caries but otherwise apparently normal, and children receiving therapeutic diets because of metabolic disturbances or disease. Caries became inactive within a few weeks after the establishment of dietary control; children who had received supervised diets for considerable periods offered little or no evidence of further caries. Markedly active and extensive caries has become inactive within three months or less with no treatment other than rigid control of the food intake. The diets prescribed have emphasized completeness in the recognized essentials rather than prohibition of any class of foodstuffs. The arrest of caries is not attributed to any one set of dietary factors, but is believed to depend on the physiologic integrity of the tooth which is to be expected when the diet approaches the optimum content of all essentials. Arrest of caries is dependent on sclerotic changes in the dentin and enamel, which occur normally in the healthy tooth in response to physiologic irritation. Sclerosis has been demonstrated histologically in sound teeth of children who have received a suitable diet continuously, and at the bases of inactivity carious cavities in the teeth of children whose diet has been made complete. The degree of sclerosis seems dependent on the adequacy of the diet. The rôle of acidophilus organisms is not primary. The presence of organisms of marked acid-producing potentialities was demonstrated uniformly in dilute saliva from children with and without caries. Many strains of *Bacillus acidophilus* were isolated from mouths in which caries had recently become inactive, and also from children who never had had caries. In order to determine the part played by oral hygiene, a 10-year-old girl with extensive and active caries was placed in the hospital on a supervised diet for four months, during which time the teeth were not brushed or otherwise cleaned. From the first observation, the teeth remained indescribably filthy. Complete arrest of caries was obtained, which was demonstrated clinically and histologically. At the end of the period, bacteriologic studies of the flora of the mouth revealed a predominance of organisms which culturally and morphologically were identical with the various strains of *B. acidophilus* which have been described by some writers

as the primary cause of caries.—Julian D. Boyd and Charles L. Drain, in *Am. J. Dis. Child.*, September, 1932.

Dental Caries and Mrs. Mellanby: In a curious article in the *Antivivisection Journal,* Mrs. Dacre Fox attacks the work of Mrs. Mellanby in connection with dental caries, recalling that if a lie be repeated with sufficient frequency it will some time or other pass for the truth, and ungenerously suggesting that the basis of the theses which have been put forward regarding vitamins is vested interest. The work of Dr. Sim Wallace receives approbation, but as he is merely used as a stick to beat Mrs. Mellanby with, he may regard the praise somewhat as a Greek gift, especially as the authoress, while apparently approving the chemico-parasitical theory associated with the name of Miller, yet disbelieves the bacterial origin of diseases. One would perhaps scarcely expect to find any carefully reasoned argument in a journal of this kind, but it is a little surprising to discover a display of animosity such as the imputation of unworthy motives to the research worker in question implies. In past times, it was a commonplace controversy to attempt to discredit one's opponent by personalities, but in more recent times it has been realized that such methods reflect more discredit upon those that employ them than upon those at whose heads they are directed. Whatever conclusion we may ultimately make concerning the value of Mrs. Mellanby's work, and there are probably at present many differing opinions about it, will be founded upon calm argument and experimental and clinical results, and not upon such articles as characterize her beliefs as "wicked doctrines."—*D. Rec.,* London.

Gas-Oxygen Anesthesia for Difficult and Bad Risk Patients in Dental Practice: Types of patients who are difficult to anesthetize are classified by Ecker (*Cur Res. Anes. & Anal.,* July-August, 1932) as (1) the heavy-set thick-necked athlete; (2) those with diseases of the respiratory passages, asthmatic, pneumonic or with pus, blood or mucus in the airways; (3) cardiac patients with mitral or aortic lesions, aneurisms of the aorta; (4) those having Ludwig's angina, or cellulitis of the neck; (5) nervous or alcoholic patients, or those with kidney disease; (6) the athletic alcoholic. In spite of this classification, the author has found that these patients often endure short anesthesia without any difficulty whatsoever, while the apparently ideal patient from the point of anesthesia may suddenly show symptoms of suffocation. It is therefore safest to regard all patients as risks. The patient is questioned regarding any previous experience with anesthesia and is asked to remove any removable dentures and to clear the air passages of mucus. The author uses the metric gas machine and always has ready for use oxygen, nitrous oxid, ethylene and a mixture of 10 per cent carbon dioxid and 90 per cent oxygen. He decries the common practice of starting and finishing with nitrous oxid, washing out the lungs and adding just a little oxygen as asphyxial symptoms appear, because, while the patient goes under more quickly, if he is a bad risk his life will be endangered temporarily. With the author's method, using a small amount of oxygen from the very beginning, this danger is avoided, speed being sacrificed to safety. If the desired depth of anesthesia is not obtained by nitrous oxid and oxygen, a small amount of ethylene is added. If there is hesitancy in breathing, from 3 to 9 per cent of carbon dioxid is added to the mixture. Emergency measures are listed as follows: 1. Withdraw the anesthetic. 2. Restore open airway, if obstructed, by pulling out the tongue or inserting the mouth-gag. 3. Slap the chest quickly and vigorously. 4. Immediately lower the head. 5. Apply hot or cold cloth to the face. 6. Dilate the sphincter ani. 7. In preference to the foregoing, use artificial respiration with carbon dioxid and oxygen, as these gases can be more quickly given and the results are more certain than the foregoing usual procedures. The author adds that he has had not the slightest difficulty in administrating ethylene in several thousand cases.

Manuscripts and Poor English: The scrutiny of hundreds of manuscripts over a term of years makes us sure of our ground when we allege that at least nine of every ten of them could be vastly improved, as literature, by a critical redaction; and of these many stand in very serious need of such redaction. Not that the violations of good usage are flagrant illiteracies. The flaws are in such things as poor paragraphing; badly constructed sentences, in which two nominatives get to quarreling with one another; plural relatives with singular antecedents, or vice versa; the excessive use of trite words and phrases; the use of the wrong word—"due to" for "owing to," "advance" for "advancement," "practically" for "almost," the use of

unjustifiable neologisms such as "minify"; the use of orphaned or fused participles; the placing of adverbs; failure to recognize a gerund; and so forward to great diversity. In addition, sentences are frequent which, while they exhibit no fault, are awkward stumbling blocks for the reader. They require re-phrasing to recapture fluidity. Often poor word-selection needs correcting. In brief, we discover that most manuscripts would be measurably improved by the ministrations of a word-smith. You will see exactly what is meant if you recall that a word-smith is a word-smoother. One may say perhaps that the difference is that between a shirt that has been ironed and one that has not. To wear the unironed shirt is entirely decent but not sartorially impeccable.—"Homily on Sand in the Sugar," Waverly Press, Inc.

MISCELLANY

BOOK REVIEWS

Human Odontography and Histology. A Text-Book for Undergraduates in Dentistry and Dental Hygiene. By Herman R. Churchill, Tandarts (Utrecht), D.D.S. (Georgetown University), Dr. Med. Dent. (Rostock), Assistant Professor of Dental Histology, Histopathology and Comparative Odontology, The Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania; Oral Pathologist at the American Oncologic Hospital of Philadelphia. Illustrated with 347 engravings and a colored plate. 298 pages. Price, $4.50 net. Published by Lea & Febiger, Philadelphia.

One of the most commendable features of this book is the emphasis given to the importance of the deciduous teeth. The significance of these teeth is becoming more and more apparent, and the author has done well to stress this point.

On page 120, he says: "The deciduous teeth are outstanding in importance from the viewpoint of dental hygiene. If a child is guided into the habit of properly attending to the care of its deciduous teeth, it will automatically transfer the habitual care of its first dentition to its permanent teeth when they gradually succeed the shed elements."

This is an excellent thing to emphasize, dealing as it does with the matter of habit. We know how prone children are to form habits, and it is essential for the child to form correct habits of mastication. A fine set of permanent teeth may be rendered nearly useless by bad habits based on neglect of the deciduous teeth, and it behooves the profession to concentrate more on this subject than they have in the past.

The descriptions of the tooth tissue are standard, and the illustrations are excellent, which is a characteristic of the publishers. The volume is commended as worthy of a place in every dental library.

The American Textbook of Prosthetic Dentistry, in Contributions by Eminent Authorities. Edited by Charles R. Turner, D.D.S., M.D., Professor of Prosthetic Dentistry and Dean of the School of Dentistry, University of Pennsylvania, Philadelphia, and L. Pierce Anthony, D.D.S., F.A.C.D., Editor of the Dental Cosmos. Sixth edition; thoroughly revised. Illustrated with 706 engravings and three colored plates. 798 pages. Price, $10 net. Published by Lea & Febiger, Philadelphia.

The cordial reception given this book in previous editions amply justifies the publication of the present volume. The book has been thoroughly revised, and much new material has been included.

The sections on partial denture service and on crown and bridgework have been particularly stressed because of the active interest in this work at the present time. Of special note in this connection is the section on injuries from faulty partial denture service.

The reviewer can but regret the omission in this edition of the chapter on con-

tinuous gum work. Difficult as this work may be, the fact remains that it exemplifies the highest expression of artistic conception in dental prosthesis, and as the best work is none too good, it would seem that there was a place for this class of service when the patient demands only the nearest possible approach to perfection.

The book as a whole is worthy of the greatest commendation, and it will add to the prestige of authors and publisher.

SOCIAL INSURANCE: COUNTER-SUGGESTIONS

By EDWARD H. OCHSNER, M.D., Chicago, Ill.

The medical and dental professions of this country are giving the American public the best all-round health service ever enjoyed by any nation and are on the whole serving the nation as well or better than any other group of men. These two professions have a very general and most intimate contact with the citizens of the nation. No other professions are in so favorable a position to exert a great influence for good as are these two, if they will but use their opportunity rightly and wisely. If they are to accomplish the greatest possible good, they must make still closer contacts with and exert still greater influence on the political, social and ethical life of the nation. These professions as a whole and as individuals must strive unceasingly and untiringly, in the future as in the past, for still further improvements in their respective fields. If unhampered by lay bureaucratic supervision and control in the future as they have on the whole been in the past, we have every assurance that they will proceed to new and greater achievements: if, on the contrary, unduly hampered, we have every reason to expect medical service to deteriorate and medical progress to cease as it has already done in those countries whose governments have interfered the most.

In order to maintain the high standard of medical service prevailing, the professions must insist that the governments of the various states maintain high standards of requirements for admission to the practice of the professions. In order to accomplish this, continued education of the public in this regard is necessary.

The organized professions, through their proper local organizations, must see to it that all undesirables are weeded out and that the individual members render efficient service for adequate and yet reasonable fees. The professional man who makes unreasonable charges for his services is an even greater menace to private practice than is he who charges too little. The former is the one to blame for most of the antagonism and resentment shown among the laity, while the latter, because of his unfair competition, makes it difficult for his colleagues to secure the necessary means for graduate work, so essential to growth and progress.

Having, through these articles, brought to the attention of my readers the defects of social insurance as practiced at present in foreign countries, and also having shown the dangers of such a system if allowed to become fixed upon the American citizen, I offer the counter-suggestion that the government, instead of wanting to take over new functions and new powers, would do better were it to make every effort to perform acceptably the duties with which it now is entrusted. We of the medical and dental professions insist that the government give better medical service to its prisoners, delinquents, insane, paupers and government wards in general, and that it give more serious attention to sanitation and hygiene, particularly to ventilation of public conveyances and places where large numbers of people congregate, and to the prevention of pollution of our sources of community water supply, such as lakes and rivers.

The allied professions in conjunction with the government should give more serious attention to the teaching of personal hygiene in our schools, colleges and universities. Our educational institutions should teach the rising generation the value of integrity, industry, thrift and frugality, emphasizing that there is no substitute for these, not even legislation. Teach them that trying to keep up with the Joneses is not necessarily a virtue and that the installment buying of luxuries and trying to keep ahead of the Browns is poor business. Teach them that to learn how to get one's money's worth and to acquire a competence are much more worth while. Teach them that trying to get something for nothing, particularly through gambling, whether it be crap-shooting, poker or buying stocks on margin, is fundamentally dishonest and almost invariably leads to disaster.

Better provisions for safeguarding the savings of our workers should be made, and if

there is no way of accomplishing this, there should be established a compulsory government insurance against sickness whereby the individual worker pays for his own insurance; in other words, medical services and cash benefits should be separated entirely. The physician should under no circumstances be medical advisor and insurance adjuster as he is in fact in all systems of compulsory health insurance now in vogue.

Social insurance is man's latest attempt at finding a means whereby social justice may be attained; but like all panaceas so far advanced, it is sure to make conditions worse rather than better. The first and most important thing is to secure honest and efficient government, and this cannot be accomplished until the general standard of honesty has greatly improved; which is simply another way of saying that there is no substitute for character of the individual members which make up a nation.

Finally, means and methods should be devised whereby remuneration and reward shall be in direct proportion to time and energy legitimately expended and to the value of services rendered to society.

While the underlying purpose of social insurance is to secure the more equable distribution of wealth and to employ the weapon of taxation in order to secure the necessities and comforts of life to the poor at the expense of those with larger incomes, the system is of necessity a failure because it does not conform with the foregoing fundamental principle of justice, but instead rewards the inefficient at the expense of the efficient; the lazy, shiftless and immoral at the expense of the industrious, thrifty and moral. While it is unquestionably true that certain individuals have been and are still receiving money for which they have not rendered an equivalent service to society, treble, quadruple or even tenfold the number of these parasites does not correct the evil. The remedy must be much more fundamental.

This formula will require the best brains of the country for its practical application, but I am firmly convinced that it is the only formula that offers a practical solution to the social and economic ills not only of the allied professions but also of society in general. If it is followed, those members of society who are doing the world's work will have enough money to employ capable dentists and physicians of their own choice and will then be assured adequate health service.

AMERICAN DENTAL ASSOCIATION TO JOIN WITH CHICAGO CENTENNIAL DENTAL CONGRESS IN 1933

The 1933 meeting of the American Dental Association will be held in Chicago in conjunction with the Chicago Centennial Dental Congress. Announcement to this effect was made at the conclusion of the recent American Dental Association meeting in Buffalo, N. Y. All the legislative and scientific sessions and the commercial exhibition will be held in the Stevens Hotel, August 7-12, inclusive. These dates were chosen so that the sessions of the Congress would be held during a most delightful week of the Chicago Century of Progress Exposition, popularly known as The World's Fair.

In order that everyone may have a proper conception of the origin of the Chicago Centennial Dental Congress, the following historical facts are recorded. Almost three years ago, when preliminary plans for A Century of Progress Exposition were being formulated, the Chicago Dental Society received a request from Mr. Rufus Dawes, president of the Exposition, to arrange for a meeting of dentists in Chicago during the period of the Exposition. It was suggested by Mr. Dawes that this meeting be international in scope and portray the progress in dentistry during the past one hundred years. This theme coincides with that of the Exposition, the purpose of which is to portray the advances made in all branches of human endeavor during the period of Chicago's existence, which will be one hundred years in 1933.

The Chicago Dental Society, in order to meet this request decided to postpone its 1933 Midwinter Clinic, originally scheduled for January, and stage a meeting during the period of the Exposition which would eclipse, from every angle, any dental meeting held up to that time. To carry out this broad purpose, the Board of Directors of the Chicago Dental Society appointed a commission which ultimately developed the Chicago Centennial Dental Congress. The Congress now functions as a separate and independent unit.

At the Memphis meeting of the American Dental Association, held in October of 1931, the officers of the Congress, consisting of Arthur D. Black, president; Hugo G. Fisher, vice-president; Stanley D. Tylman, secretary; and Christian Davidson, treasurer, presented to that Association an invitation to

hold its 1933 meeting in Chicago in connection with the Congress. The invitation was tentatively accepted and a committee was appointed to work out the details with officials of the Congress. Several meetings were held and a mutually satisfactory agreement reached. This special committee of the American Dental Association reported to the association in Buffalo when final action was taken.

With the cooperation of the Editor of THE JOURNAL, there will be given, in the several issues to be published before the opening of the Congress, complete and detailed information concerning this great dental congress. It is believed that every member of organized dentistry throughout the world will want to attend and see and learn what his profession has done for the health and happiness of the human race.

The vacation aspect of A Century of Progress Exposition is immediately apparent. Never in the history of dental meetings has there been the equal of such an opportunity to combine business, education and pleasure.

The Chicago Centennial Dental Congress invites you. Make your plans now, distant as the date may seem, to participate in and enjoy the benefits of a dental gathering which will be a landmark in the annals of our profession.

NEWS

Orthodontists Issued Certificates of Qualification: At the meeting of the American Board of Orthodontia, held in Toronto, Ontario, in May, the following orthdontists met the requirements of the Board and have been issued certificates of qualification: Fred R. Blumenthal, Boston, Mass.; Charles F. Bowles, Richmond, Va.; Archie B. Brusse, Denver, Colo.; George H. Caddick, Albany, N. Y.; Stanley S. Crouch, Toronto, Ontario; Bernard G. DeVries, Minneapolis, Minn.; George Vernon Fisk, Toronto, Ontario; Ashley E. Howes, New Rochelle, N. Y.; Andrew F. Jackson, Philadelphia, Pa.; Leland R. Johnson, Chicago, Ill.; C. Angus Kennedy, Toronto, Ontario; *Victor W. Lay, Buffalo, N. Y.; William J. Lea, Vancouver, British Columbia; George R. Moore, Ann Arbor, Mich.; Lowrie J. Porter, New York City; Allen E. Scott, San Francisco, Calif.; Earl W. Swinehart, Baltimore, Md.; Kirman E. Taylor, Denver, Colo.; Charles J. Vosmik, Cleveland, Ohio; Fred Wolfsohn, San Francisco, Calif.

DEATHS

Corbitt, George B., North Judson, Ind.; Northwestern University Dental School, 1901; was killed in an automobile accident near Windsor, Ontario, September 24.

Cowen, W. H., Chicago, Ill.; Chicago College of Dental Surgery, 1889; died suddenly, October 13, of heart disease; aged 65. The widow, two sons and a daughter survive.

Eschelman, Simon, Buffalo, N. Y.; Temple University School of Dentistry, 1875; died, September 26; aged 80. Dr. Eschelman was also a graduate of the Royal College of Dental Surgeons, Toronto and of the University of Vermont School of Medicine. He was an ex-president of the Buffalo and the Eighth District Dental societies and a charter member of the American College of Dentists. The widow and two sons, Karl F., D.D.S., M.D., and Leo S., D.D.S., survive.

Reed, Chester B., Topeka, Kan.; died suddenly, September 22. Dr. Reed was one of the leaders of the dental profession. The widow and two children survive.

Bagnall, John Stephen, Charlottetown, Prince Edward Island, Canada; Tufts College Dental School, 1878; died, September 22; aged 80. Dr. Bagnall retired in 1928 after practicing for fifty years.

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*Deceased.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association in conjunction with the Chicago Centennial Dental Congress, Chicago, Ill., Aug. 7-12, 1933.

American Society of Orthodontists, Oklahoma City, Okla., April 19-21.

Dental Protective Association of the United States, Chicago, Ill., December 19.

Eastern Association of Graduates of Angle School of Orthodontia, New York City, November 14.

Greater New York December Meeting, New York City, December 5-9.

Odontological Society of Western Pennsylvania, Pittsburgh, November 8-10.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Society of Orthodontists, Knoxville, Tenn., October 31-November 2.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

November

Florida, at Hollywood (3-5).

December

Ohio, at Cleveland (5-7).

February

Minnesota at Minneapolis (7-9).

April

Connecticut at Bridgeport (19-21).
Michigan, at Grand Rapids (10-12).
Tennessee at Knoxville (27-29).

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, December 12. Board of Dental Examiners, California State Bldg., Los Angeles.

Connecticut, at Hartford, November 16-19. Almond J. Cutting, Recorder, Southington.

Indiana, at Indianapolis, November 14. J. M. Hale, Secretary, Mt. Vernon.

Massachusetts, at Boston, November 14-16. W. Henry Grant, Secretary, State House, Boston.

New Jersey, at Trenton, December 5-10. John C. Forsyth, Secretary, 148 N. State St., Trenton.

Rhode Island, at Providence, December 6-8. Albert L. Midgley, Secretary, 1108 Union Trust Bldg., Providence.

Wisconsin, at Milwaukee, December 12-17. S. F. Donovan, Secretary, Tomah.

Pennsylvania, at Philadelphia and Pittsburgh, December 7-10. W. A. McCready, Secretary, 1115 Highland Bldg., Pittsburgh.

North Dakota, at Fargo, January 10-13. R. E. Percy, Secretary, Mandan.

TENNESSEE STATE DENTAL ASSOCIATION

The Tennessee State Dental Association will hold its sixty-sixth annual meeting at Knoxville, April 27-29.

E. Jeff Justis, *Sec'y-Treas.*
Exchange Bldg.
Memphis

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the North Dakota State Board of Dental Examiners will be held at the Gardner Hotel, Fargo, January 10-13. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to date of examination. For further particulars, address

R. E. Percy, *Secretary*,
Mandan

CONNECTICUT STATE DENTAL ASSOCIATION

Owing to a conflict of dates of the meeting of the Massachusetts Dental Association and

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of The Journal.

the Connecticut State Dental Association, the latter will meet April 19-21, at the Stratfield Hotel, Bridgeport.

C. W. VIVIAN, *Secretary,*
New Britain

PENNSYLVANIA STATE BOARD OF DENTAL EXAMINERS

The Pennsylvania State Board of Dental Examiners will hold its next examination, December 7-10, at Philadelphia and Pittsburgh.

W. A. MCCREADY, *Secretary,*
1115 Highland Bldg.,
Pittsburgh

DENTAL PROTECTIVE ASSOCIATION OF THE UNITED STATES

The annual meeting of the Dental Protective Association of the United States will be held at the Palmer House, Chicago, December 19, at 4 p. m. The report of the officers will be given, a board of directors will be elected and other business will be transacted. All members are urged to be present.

By order of the Board of Directors.

E. W. ELLIOT, *Secretary,*
55 E. Washington St.,
Chicago, Ill.

FEDERATED GUILDS OF ST. APOLLONIA

The third annual convention of the Federated Guilds of St. Apollonia will be held in Boston, Mass., November 6-7. For further information, address

JOHN O. EGAN,
279 Bowdoin St.,
Dorchester, Mass.

MT. SINAI HOSPITAL LECTURE COURSE

(Change of Date)

The lecture scheduled for November 8 in the second lecture course on dental medicine to be given at Mt. Sinai Hospital, New York City, has been postponed to November 15.

RALPH H. BRODSKY

THE SIGN OF DISTRESS

Many are giving the sign of distress during this unfortunate era. Many dentists are in dire need, and although you may have felt the effects of the hard times, please remember that there are others in a more unfortunate condition than you are.

You will receive your allotment of seals from the Relief Fund Committee. Do not delay your remittance, for the satisfaction of hunger, the substitution of warmth for cold and the relief of pain and misery depend on your help.

This year above all others, HELP.

Relief Fund Committee of the
American Dental Association
R. OTTOLENGUI, *Chairman*
OLIN KIRKLAND
W. T. CHAMBERS
EDWARD G. LINK
FRED R. ADAMS, *Secretary*

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

The next examination of the Board of Dental Examiners of California will be held in San Francisco, beginning December 12. Credentials of all applicants must be in the office of the Board of 450 McAllister St., State Annex Bldg., at least twenty days prior to the date of examination.

K. I. NESBITT, *Secretary,*
450 Sutter St.,
San Francisco.

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1932-1933

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